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Rolla, Missouri

ILLUSTRATIONS

LETTER OF TRANSMITTAL

Rolla, Missouri
November 22, 1955

Honorable Phil M. Donnelly
Governor of Missouri
Jefferson City, Missouri

Dear Governor Donnelly:

I have the honor and pleasure to transmit herewith a report on THE SUBSURFACE GEOLOGY OF THE MISSISSIPPI EMBAYMENT OF SOUTHEAST MISSOURI, by John G. Grohskopf.

The Embayment Area of southeast Missouri contains large quantities of high quality groundwater and is also of interest to oil and gas wildcatters. This publication with its contained logs and plates will be an invaluable reference to future drilling activity. Within the report area, there is an exceptionally thick section of rock units which are absent in other parts of the state and there has long been a demand for a detailed geologic report such as this. A series of publications on the subsurface geology and oil and gas possibilities of northwestern and northeastern portions of the state is now expanded by this report on southeast Missouri.

Respectfully submitted,

THOMAS R. BEVERIDGE
State Geologist

Subsurface Geology of the Mississippi Embayment of Southeast Missouri

JOHN G. GROHSKOPF

ABSTRACT

To the southeast of the Ozark Escarpment all municipal, industrial, and agricultural water supplies of record are obtained by drilled wells from alluvial sands and gravels, unconsolidated sands of the Wilcox and McNairy (Ripley) formations, and at a few towns from consolidated Paleozoic dolomites, limestones, and sandstones. The irrigation wells obtain their water supply from the Alluvium. These wells have recorded yields of several thousand g.p.m. and the water, though excessively high in iron, is still satisfactory for the irrigation of crops. Some municipal and industrial supplies are obtained from the Wilcox sands, but the water usually requires iron-removal treatment. The deeper sands of the McNairy (Ripley) yield a very soft and relatively low iron water which is utilized for municipal supply at some towns. The McNairy (Ripley) formation offers a source of supply for textile and similar industries which require a soft water with low iron content. Southeast of Crowleys Ridge the Paleozoic formations have not been developed because they are excessively deep and they produce sulphosaline water.

The occurrence of asphalt in some of the deeper wells indicates a possibility for commercial accumulations of oil. The Pascola arch which is the largest known structure in the area has had some test drilling with negative results. However, there is always the possibility that oil may be trapped on the flanks of this structure and only additional drilling will completely condemn it.

INTRODUCTION

The New Madrid earthquake of 1811-1812, which was one of this Country's major seismic disturbances, probably stimulated interest in southeast Missouri. Various investigators have examined the area, but their work has been greatly hampered by the blanket of alluvial and loessial material which covers much of the area and effectively conceals most of the strata. This cover has made it difficult to obtain a detailed and complete record of the geology.

In 1932 fossiliferous strata of Cretaceous age were found cropping out near Ardeola, Stoddard County, by F. E. Matthes (1933). Although it had been suggested previously, this was the first authentic identification of Cretaceous strata in the area. This discovery stimulated further geologic investigation of the area by the Missouri Geological Survey.

This report when it was begun in 1938 by H. S. McQueen, then Assistant State Geologist, in collaboration with D. R. Stewart and L. McManamy, included a Magnetic Map of southeast Missouri. This map, which was published by the Missouri Geological Survey, also showed the location of various deep drill holes. In the fall of 1944 W. F. Pond, then State Geologist of Tennessee, suggested that Kendall Born, deceased, join with the writer in preparing a joint report including Missouri and adjoining portions of Tennessee, Kentucky, and northeast Arkansas. The joint report, desirable as it would have been, was abandoned, and the writer restricted his efforts in the main to the Missouri portion. Following World War II, there was considerable interest in the possibilities of oil and gas in this part of the state. These tests, together with several additional water wells, supplied sufficient information to warrant revision before publication. The drought of 1953 and 1954 has stimulated irrigation in the area, so it is believed advisable to publish this report to help guide those interested in well water supplies for irrigation.

Figure 1
Map showing location of the area.

LOCATION AND AREA

The area covered by this report is that part of southeastern Missouri which is underlain either wholly or partially by Gulf

Coastal Plain sediments. The eastern boundary is the Mississippi River and the southern boundary the Arkansas State line. The Ozark Escarpment, which is the northwestern boundary, divides the lowland area from the Ozark province (plate VIII). This northwestern boundary is not sharply defined because isolated outcrops of Gulf Coastal Plain sediments have been found in that area of the Ozark province bordering the lowlands. From the presence of these outcrops it is evident that the northwestern limit of the sediments commonly assigned to the Mississippi embayment is at least 20 miles to the northwest of the Ozark Escarpment. The area includes approximately 1600 square miles northwest of the Ozark Escarpment and 3900 square miles southeast of the Escarpment, or a total of 5500 square miles; see maps, plate I and figure 1. The entire area has been topographically mapped either by the United States Geological Survey in cooperation with the Missouri Geological Survey or by the Corps of Engineers, U. S. Army. Quadrangle maps are available on a scale of 1:62,500 and with a 20 foot contour interval in the hill areas and a 5 foot contour interval in the lowlands. These maps may be purchased for 20 cents each from the Missouri Geological Survey. An index map showing the location and identification of these quadrangles is available on request from the Missouri Geological Survey.

ACKNOWLEDGMENTS

Fossils contained in samples from several critical holes were identified by geologists of the U. S. Geological Survey and others. Such identifications are acknowledged in the written logs of the wells. The late Kendall Born furnished samples and locations for several wells in western Tennessee. That portion of the Geologic Map, plate II, which lies southeast of the Ozark Escarpment is taken from Farrar (1935) and from manuscript maps of Dan R. Stewart. Well drillers and oil operators who cooperated in giving information are acknowledged by name on the well logs which they furnished. The writer acknowledges the work of Mary Hundhausen McCracken who very patiently picked out the microfossils from the Cambrian formations in the Strake well, Pemisot County, Missouri, and the Markham well, Lake County, Tennessee. The petrographic descriptions of the intrusive rocks by Margaret W. Skillman Woyski are given and acknowledged in the body of this report. The unpublished manuscript of Stewart and McManamy (1942) has been drawn upon for source material of the Mesozoic and Cenozoic formations. The identifications of the Canadian formations were checked by Earl McCracken. Especial thanks are given to Edward L. Clark and Walter V. Searight for editing portions of the manuscript. Mrs. Esther Friedlein and Miss Bonnie Wills did the final and somewhat difficult typing of the manuscript.

SCOPE OF THE REPORT

The index map (plate I) shows the location, total depth, and the formation in which wells were completed for most of the important wells drilled in the area. The map also shows civil boundaries and towns, and may serve as a base map for other uses. The surface geology of the area is shown on plate II. The distribution of the Paleozoic formations is taken in the main from the State Geologic Map (1939) with modifications from manuscript maps by Stewart (1942). The Mesozoic and Cenozoic areal geology is taken from Farrar (1935) and from a manuscript map prepared by Dan R. Stewart (1942). The present report is concerned chiefly with the subsurface geology.

The distribution of the Paleozoic formations lying beneath the Cretaceous is shown on plate III. This map represents the writer's interpretation based on limited information. The map is a general guide and should be so used; any deviation from it revealed by subsequent drilling does not necessarily indicate abnormal geologic conditions. Similar remarks apply to the accompanying structure maps.

Logs of the ninety-nine holes shown on plate I are published herewith. Drilling time summaries are given with some logs along with other pertinent information.

Quality of ground-water from various formations is shown by chemical analyses (tables 1 to 5 and figure 3). Ground-water temperatures at various depths are indicated in figure 2.

The stratigraphic column of the area is presented in plate IX. This is amplified by descriptions in the text and in the logs of the various wells, and in the section titled Stratigraphy.

The cross section (plate VII) gives the author's interpretation of the attitude of the strata. Attention should be called to the indicated unconformity at the top of the Smithville-Powell formations; as drafted on the cross section this might be misinterpreted as a lensing or pinch out.

PREVIOUS WORK

The references cited list the previous work in the area of this report as well as contiguous areas thereto. Shepard (1907, pp. 24-29) presented an excellent description of the occurrence of ground water. His work also included logs of some wells and limited stratigraphic and structural discussions. Marbut's discussion of the physiographic history of the area (1902) is still accepted as the best presentation of this subject. Fisk (1944) showed the old channels of the Mississippi River and combined the physiographic history with some subsurface information; his colored maps of the old river channels are very enlightening. Freeman (1945, pp. 12-43) discussed the subsurface Paleozoic of western Kentucky and presented subsurface maps and cross sections. Farrar, Grenfell, and Allen (1935) described the location, character,

and physical properties of the various clays of the Mesozoic and Cenozoic. Farrar and McManamy (1937) also discussed the geology of Stoddard County. Fuller (1912) gave an extremely interesting and nontechnical description of the New Madrid earthquake of 1811-1812. Wilson (1922, pp. 263-264) presented logs of some holes in his description of the area.

GENERAL DESCRIPTION OF THE AREA

The Mississippi embayment is a broad arm of the Gulf Coastal Plain which extends up the valley of the Mississippi River from the Gulf of Mexico to southeastern Missouri and southern Illinois. The outer rim of this area is approximately outlined on the west, north, and east by outcrops of consolidated Paleozoic sediments. Structurally the embayment is a downwarped, spoon-shaped trough developed on the Paleozoic rocks. The trough has since become filled to the level of the present surface with unconsolidated or poorly consolidated sediments of Mesozoic and Cenozoic age. The axis of the trough has a trend of about N. 30° E. and is roughly marked by the general course of the present Mississippi River.

The lowland district of southeastern Missouri occupies the northwestern "quadrant" of the Mississippi embayment and is flanked on the northwest by the Ozark province. The maximum depth to the Paleozoic rocks in the embayment is slightly more than 2700 feet in the southeastern part of Pemiscot County. The Cenozoic and Mesozoic sediments which fill the Missouri portion of the trough have a general southeast dip ranging from 25 to 30 feet per mile and trend in crescent-shaped bands running from N. 30° E. to almost E. and W.

The region as a whole is a broad flat plain with a gentle slope to the south. Except for the remnants of uplands and a few terraces, the surface variations in altitude are generally less than ten feet. The surface altitude of 335 feet in the northern part of the area along the base of the Ozark Escarpment decreases to the south border of the state where the altitude averages 240 feet.

The two most prominent topographic features of the area are the Benton Hills and Crowleys Ridge. The Benton Hills are in northern Scott County just south of the town of Cape Girardeau. They are separated from the uplands by a narrow strip of lowlands. Crowleys Ridge extends in a southwesterly direction from the Benton Hills to a point where the St. Francis River flows from Missouri into Arkansas (plate VIII). These remnants of old uplands rise from 50 to 150 feet above the surrounding lowlands. The east and north slopes of these ridges are abrupt, but to the west they grade off imperceptibly into the lowland.

Minor topographic features that break the monotony of the lowlands are flat-topped terraces 20 to 30 feet above the general level of the lowlands. The most prominent of these terraces are Sikeston Ridge extending southward from the Benton Hills to the

vicinity of the town of New Madrid, and the Kennett-Malden Prairie extending south from Crowleys Ridge through Dunklin County into Arkansas.

Other terraces, Melville Ridge, Ash Hills, and Dudley Ridge lie to the west of Crowleys Ridge in Butler and Stoddard Counties. Crowleys Ridge and the Benton Hills are topographic features resulting from a complex series of events incident to the history of the region to the north and east. Further discussion of these features is beyond the scope of this report.

STRATIGRAPHY

Stratigraphic Summary

The stratigraphic relations and comparative thickness of the formations are shown by the cross section (plate VII) and are summarized in the columnar section given in plate IX; thicknesses are not repeated in the text. Facies changes, from dolomite to carbonaceous black shale and limestone, occur in some of the Cambrian and Canadian sediments in the subsurface southeast of the Ozark Escarpment. The relative ages of the formations in the subsurface were determined by correlating these formations with corresponding rock units which had been exposed in outcrops and drill holes and for which ages had been established. Such correlation was made by using the characteristics of lithology and insoluble residues (Grohskopf and McCracken, 1949).

A knowledge of the character of the Paleozoic rocks and their insoluble residues as noted in hundreds of wells in the Ozark province is a distinct asset in correlating the subsurface strata. Lithology, stratigraphic position, electrical logs, and drilling time were of great value for correlating the Mesozoic and Cenozoic strata. Fossils obtained in cuttings from certain wells were of highest value for making correlations more certain. Rotary samples from some of the holes were not completely satisfactory, especially in the Mesozoic and Cenozoic, unless accompanied by drilling time and electrical logs.

A trough or basin that existed in Cambrian time is indicated by the extraordinary thickness of 1580 feet of the Bonneterre formation in the Strake well (log No. 1, Pemiscot County) where drilling to a depth of 4740 feet failed to reach pre-Cambrian rocks, after penetrating 2680 feet of Ozarkian and Cambrian sediments.

Post-Cambrian intrusive igneous rocks have been encountered in the Upper Cambrian series (of Ulrich) in two holes in the area. The description of these rocks will be more fully discussed later.

The Gulf Coastal Plain deposits of the Mississippi embayment are composed of sediments of Mesozoic and Cenozoic age. These sediments were deposited in a downwarped trough, or geosyncline, which extends from the Gulf of Mexico as far north as southeastern Missouri and which was developed on faulted and

folded Paleozoic rocks at the close of the Paleozoic Era. In southeastern Missouri, deposition in this trough began in upper Cretaceous time and continued, with several interruptions, into the Tertiary with deposits of Paleocene, Eocene, and Pliocene (?) age being represented. In Pleistocene and Recent times, the lowlands were developed with their alluvial deposits and a thick blanket of loess was spread over the upland areas. Faulting and folding accompanied each depositional interruption and affected the area to varying degrees.

For the most part, the Cretaceous and Tertiary sediments consist of unconsolidated or poorly consolidated marls, sands, and clays of both marine and non-marine origin. In the lowland area they were buried by alluvial material to depths ranging from a few feet to 200 feet, and in the upland areas they are almost completely masked by loess deposits. Outcrops of these sediments are confined entirely to the upland areas of Crowleys Ridge and scattered localities along the margin of the adjacent Ozark province. Even in the hill areas, outcrops are few and are restricted to the steeper slopes and the deeper valleys where the thick mantle of loess has been removed.

In southeastern Missouri, the sediments dip to the southeast. These dips range from 35 feet per mile on the peneplained surface of the Paleozoic rocks (plate IV), to 30 feet per mile at the base of the Cenozoic (plate V), and to 25 feet per mile on top of the Midway (plate VI). The thickness of Cretaceous and Tertiary beds ranges from a few feet in the outcrop area to more than 2700 feet in the extreme southeast corner of the state.

PROTEROZOIC ERA

Pre-Cambrian System

Rocks of pre-Cambrian age crop out 15 to 20 miles northwest of the Ozark Escarpment in Sam A. Baker State Park, T. 35 N., R. 4 E., and R. 5 E., (plate II). The exposures mentioned above are dark colored rhyolite porphyry. They occupy several square miles of area and are immediately overlain by Upper Cambrian sediments which consist of dolomites of the Bonneterre formation; the Lamotte sandstone which ordinarily overlies the pre-Cambrian is here absent owing to local overlap by the Bonneterre against knobs on the pre-Cambrian surface. No pre-Cambrian rocks are known in the area southeast of the Ozark Escarpment.

PALEOZOIC ERA

Cambrian System

UPPER CAMBRIAN SERIES of Ulrich

The Paleozoic strata in the Ozark province have been well described by Bridge (1930), Dake (1930), and Weller and St.

Clair (1928). The columnar section (plate IX) also amplifies somewhat the descriptions which follow.

Lamotte ? formation.—An unfossiliferous quartzite which may be a correlative of the Lamotte sandstone was drilled in the Strake well (log No. 1, Pemiscot County) and the Marr well (log No. 11, Stoddard County) as shown in plate VII. A well in Lake County, Tennessee, (Markham well, log No. T6) also encountered quartzite in the lower portion of the hole. The quartzite in all the holes is dark gray, extremely fine grained, hard and compact, and somewhat calcareous and dolomitic. It is overlain by limestone and calcareous and dolomitic shale which contain fossils commonly found in the Bonneterre formation in the outcrop area near Farmington, Missouri.

The lower portion of the Bonneterre is somewhat quartzitic and the contact with the underlying quartzite is one of gradation. Because of this gradation, its stratigraphic position and the geographic proximity to known Lamotte to the northwest in the Ozark Escarpment, the quartzite is believed to be an equivalent to the Lamotte sandstone; it may later prove to be equivalent to the Middle Cambrian quartzites in Alabama. No well in the area has drilled through the quartzite into underlying rocks. The Strake well (log No. 1, Pemiscot County) penetrated 90 feet of the quartzite.

Bonneterre formation.—The Bonneterre formation has been identified in the subsurface of the area by fossils from the Strake well (log No. 1, Pemiscot County) and the Markham well (log No. T6, Tennessee). In the Strake and Markham wells the Bonneterre is overlain by Cretaceous formations. The lithology of the Bonneterre as shown by core samples in the above wells is hard, black, calcareous, dolomitic, carbonaceous, "poker chip" shale with a white, glauconitic, oolitic, and quartzitic limestone in the lower 200 to 300 feet. The fossils were found in both lithologies. The Bonneterre seems to lie conformably above the quartzite tentatively correlated as Lamotte. The Bonneterre in the holes of record in the area is overlain by formations which range in age from Upper Cambrian to Cretaceous, depending upon the location of the hole with respect to structure. The thickness of the Bonneterre ranges from 1270 feet in the Marr well to 1580 feet in the Strake well. Until fossil evidence conclusively proved otherwise the black shale in the Markham well was correlated on the basis of lithology and regional geology by some geologists as either Atoka (Pennsylvanian) or possibly Mississippian.

Elvins group (Ulrich).—Approximately 600 feet of glauconitic and silty dolomite, resting below typical drusy Potosi dolomite and above the Bonneterre formation in the Strake and Marr wells, is assigned to the Elvins group even though formational delimitations have not been made. The insoluble residues, although darker than is usual for these formations, nevertheless contain the silt,

fine glauconite, kaolinite, and waxy green shale which serve for the identification of this group in other nearby areas where the stratigraphic sequence is the same.

Post-Cambrian Igneous Rocks

Intrusive igneous rock of post-Cambrian age have been drilled in two holes in Pemiscot County, Missouri, and in one hole in Lake County, Tennessee. Margaret Skillman Woyski, formerly of this Division, made thin sections and petrographic examinations of these rock fragments. Her unpublished memorandum (1947) concerning these examinations is herewith quoted in part.

Strake well: (Log No. 1, Pemiscot County, Missouri.)

Fragments of material logged as basic dike rock were thin sectioned. The texture is felsitic to fine-grained, somewhat porphyritic with subhedral mafic minerals in a carbonate ground mass. The minerals are dominantly red biotite, colorless augite (diopside?), and a carbonate—probably ankerite. Melilite, magnetite, and pyrite are abundant accessories. The most common alteration products with the dike material are perovskite (?), talc (?), epidote (?), calcite, pyrite, galena, chalcopyrite, and red manganiferous limestone. The minerals were identified by unavoidably incomplete optical measurements. The rock logged as basic dike is of igneous origin. The texture and composition are remarkably different from common basaltic, diabasic andesitic dike rocks, but are similar to lamprophyric dikes. The dike rock in the Strake well falls in the alnoite division of the classification of lamprophyres. The unusual composition of the dike rocks in this area suggests a close relationship to the lamprophyric dikes and distremes of Ste. Genevieve and St. Francois Counties described by Kidwell (1947).

Killiam well: (Log No. 6, Pemiscot County, Missouri.)

Fragments logged from this well as "igneous material" appear to be lamprophyre similar to that in the Strake well.

Linda Morris well: (Log No. T5, Lake County, Tennessee.)

Fragments logged as "serpentine" are green minerals similar to the alteration products associated with lamprophyre in the Strake well. The minerals are very fine grained but appear to belong to the chlorite-serpentine group. No fragments of dike material were observed.

Markham well: (Log No. T6, Lake County, Tennessee.)

Fragments logged as "basic dyke" seem to be altered lamprophyre similar to that in the Strake well. Some of the fragments logged as "serpentine" and "metamorphic" may also be altered lamprophyre, or may be green alteration minerals associated with the lamprophyre. The pink rock associated with the lamprophyre at about 3300 feet depth is a fine grained aggregate with minute hematite inclusions which give the pink color. The chief minerals appear to be potash feldspar and a carbonate.

Ozarkian System of Ulrich

Potosi formation.—The Potosi is a dark brown coarsely crystalline vuggy dolomite. The vugs are lined with drusy quartz which is banded.

Eminence formation.—Most of the wells in the area indicate that this formation is similar in character to cuttings found in wells to the northwest in the Ozark province where the Eminence consists of light colored medium to coarsely crystalline dolomite which may be somewhat siliceous. As with the underlying Cambrian formations, there is some limestone present in a few wells with a tendency for the dolomite to be dark in color. The contact of the Eminence with the underlying Potosi is ordinarily placed at the appearance of quartz druse and a change to darker colored rock. The contact with the overlying Gunter member of the Van Buren formation is not readily delineated in the area.

Gunter member of the Van Buren formation.—The Gunter in the type area is a sandstone, but the subsurface to the southeast reveals a change to sandy dolomite or dolomite with sand and thin green shale beds which are only a few inches thick. Where such is the case, it is usually designated as the "Gunter Zone".

Van Buren formation.—The Van Buren formation is recognized in the area, but because the contact with the overlying Gasconade is obscure the Van Buren is usually not separated from the Gasconade in subsurface studies. Ordinarily the Van Buren consists of medium to coarsely crystalline dolomite with very characteristic dolomoldic white chert in the lower portion (Grohskopf and McCracken, 1949). In the Mack well (log A5, Mississippi County, Arkansas), the Van Buren and Gasconade formations are dark dense limestone, but in Missouri these formations, where noted, are dolomite.

Gasconade formation.—The Gasconade formation is well developed in the area as a coarsely crystalline dolomite which is extremely cherty in the lower portion.

Canadian System of Ulrich

Roubidoux formation.—The Roubidoux in the area consists of dolomite intercalated with sandstones which appear to be only a few feet thick. The prominent sandstones so well developed in the Ozark province are absent in this area. In the Mack well (log No. A5, Mississippi County, Arkansas), the Roubidoux is limestone.

Jefferson City formation.—The Jefferson City in the area consists of somewhat cherty dolomite and several thin sandstone beds. In the Oliver well (log No. 6, New Madrid County), 50 feet of dense limestone were included in the basal portion. In the Mack

well (log No. A5, Mississippi County, Arkansas), the entire Jefferson City formation is dark dense limestone.

Cotter formation.—Some strata in the subsurface of the area are very similar to the Cotter formation as known in wells in the Ozark province. In both areas the Cotter is a finely crystalline to granular dolomite which is intercalated with very thin green shales and sandstones; the dolomite containing dolomoldic and oolitic cherts.

Powell ? and Smithville ? formations.—The Powell formation has been mapped in Ste. Genevieve County (Weller and St. Clair, 1928), but has not been traced without question into the area. In Ste. Genevieve County the so called Powell formation is an argillaceous and siliceous dolomite with sandstone in the lower portion. If present in the area it may have been included in the Cotter and Smithville formations.

Smithville faunas were collected by Dan Stewart (unpublished notes) and Heller (1943) from residual chert fragments in clay overlying the bed rock over a large area in southern Bollinger County. Heller cites one locality in sec. 34, T. 31 N., R. 9 E., where Smithville fossils were found in dolomite.

Stewart (personal communication, 1948) also gives one locality at the G.G. Hill quarry near Delta in sec. 8, T. 29 N., R. 12 E., Cape Girardeau County where Smithville fossils were found in the solid dolomite. The "Smithville-Powell" dolomite has been traced into the area through wells (plate VII). Because of their similarity in lithology and insoluble residues, the "Smithville and Powell" are not separated in this report.

Ordovician System

Everton formation.—The Everton formation in Cape Girardeau and Scott Counties consists chiefly of light to dark colored dolomite which is characterized by embedded or "floating" grains of sand, by thin green and brown shale, and by sandy chert. In wells in the above counties a comparatively fine-grained sandstone has been observed at the top of the formation. The Everton is not known south of the probable fault in southern Scott County (plate III).

St. Peter formation.—The St. Peter sandstone in eastern Missouri has been so well described (Dake, 1918) that detailed description of the lithology need not be repeated. In general, it consists of fine to medium grained sand; the grains being characteristically well-rounded and frosted. In the Midwest Dairy Company well in the town of Cape Girardeau (log No. 1, Cape Girardeau County), 65 feet of sandstone which has characteristics of both Everton and St. Peter were penetrated. The distribution of the St. Peter is the same as that of the Everton (plate II). The two have been grouped together in this report.

Dutchtown formation.—The Dutchtown formation contains comparatively pure limestones, highly argillaceous limestones, magnesian limestones, dolomites, and dolomitic sandstone. The limestones and dolomites are generally dark colored with brown, dark-blue, and black predominating, although white, light-gray, and bluish-gray colors are present. The textures of these rocks vary from dense to somewhat granular and finely crystalline. The distribution of these rocks are not indicated separately on plate II. They are included with overlying Ordovician formations up to and including the Kimmswick formation. The Dutchtown crops out in southeastern Cape Girardeau County and in northern Scott County where it is also known in wells. The Dutchtown is not known south of the fault in southern Scott County. This apparent absence may be due to lack of subsurface control.

Joachim formation.—The Joachim formation is a dolomite or magnesian limestone with a very thin chert zone at the top and with thin beds of shale and sandstone in the lower portion. The distribution of the Joachim formation in the area is similar to the underlying Dutchtown.

Rock Levee formation.—The Rock Levee formation includes certain dense limestones which were formerly included in the Plattin formation and which lie beneath an oolitic and conglomeratic limestone in the base of the Plattin. The Rock Levee also includes dolomites formerly included in the upper part of the Joachim formation and which lie just above a thin chert zone that marks the top of the Joachim formation. The distribution of the Rock Levee in the area is similar to that of the Dutchtown and Joachim.

Plattin formation.—The Plattin formation is very simliar in lithology to the Dutchtown with which it has been confused by some geologists. However, the basal Plattin contains oolitic and conglomeratic limestones which have not been noted in the Dutchtown. The distribution of the Plattin in the area is much the same as that of the Dutchtown, Rock Levee, and Joachim except that small isolated blocks of the Plattin limestone have been noted in fault blocks in the vicinity of Marble Hill, Bollinger County (Heller, 1943).

Decorah formation.—The Decorah formation consists of intercalated limestone and shale with a thin metabentonite seam at the base. The Decorah has been noted in the Midwest Dairy Company well (log.No. 1, Cape Girardeau County). It extends only a few miles to the south into the area and is confined chiefly to the wells in the extreme northeastern part of Scott County.

Kimmswick formation.—The Kimmswick formation is a light colored very pure almost white limestone in the vicinity of Grays Point, Scott County. It is even more restricted in distribution in the area than the Ordovician formations previously described. It

is known in only a few wells and outcrops in northern Scott County. Similar to the Plattin, it is present in isolated fault blocks at Marble Hill locality in Bollinger County (Heller, 1943).

Thebes-Maquoketa formation.—The Thebes-Maquoketa formation consists of a body of shale with a sandstone in the middle portion which is known as Thebes. In the area, the formation is known at the outcrop in the City of Cape Girardeau and it extends south to the mouth of Albright Creek, 2.25 miles north of the town of Commerce in Scott County where it is preserved in a fault zone. This is the southernmost known outcrop of the formation in Missouri, but lack of subsurface control to the south may be the reason for its apparent absence.

Devonian and Silurian Systems

Rocks belonging to these systems crop out in eastern Cape Girardeau County in an area approximately 20 miles long, north and south, and 10 miles wide, east and west. The formations identified are indicated in plate IX. These formations are also known to be present in the fault blocks at Marble Hill (Heller, 1943).

The geologic maps (plate II) shows the presence of the Devonian and Silurian formations to the southeast of the Ozark Escarpment, T. 28 N., R. 11 E. and T. 29 N., R. 14 E., where they are preserved in fault blocks. In these exposures the formations were readily identified by their lithology, but because of the jumbled attitude of the beds no measurements of their thickness was practicable. The thickness given in plate IX is the maximum for all these formations as known in Cape Girardeau County. No Devonian or Silurian formations are known to the south of the southern Scott County fault. This absence may be more apparent than real because of the dearth of subsurface control to the south.

MESOZOIC ERA

Cretaceous System

GULF SERIES

McNairy (Ripley) formation.—The name "McNairy sand member" was proposed by L. W. Stephenson (1914) for the extension northward into Tennessee of the typically marine beds of the Ripley formation of Mississippi. The "McNairy sand member" included the overlying Owl Creek formation, but in 1926 Bruce Wade (1926, pp. 7-8) redefined the Ripley formation in Tennessee and placed the McNairy sand member between the Owl Creek beds above and the Coon Creek horizon below. The beds of the McNairy sand member of the Ripley formation were first recognized in southeastern Missouri by L. W. Stephenson in 1932 (Matthes, 1933, pp. 1003-1009).

In southeastern Missouri, the sand and clay of Ripley age are the oldest Cretaceous deposits that crop out and since the term Ripley is restricted to the marine sand and clay of upper Selma age in Mississippi it seems highly justifiable to raise the term McNairy to formational rank for use in southeastern Missouri (Stephenson, 1942).

Wells in the deeper portion of the embayment encounter Cretaceous beds below the McNairy that do not crop out at the surface. These beds are of both marine and nonmarine origin and consist of unconsolidated or poorly consolidated sand, chalk or marl, clay, and thin limestones. These lower sediments are completely overlapped by the McNairy and may represent deposits of lower and middle Selma age. They roughly correlate with the Ozan and Marlbrook-Saratoga units of the Arkansas section. As used in this report the McNairy formation includes sand and clay that lie below the Owl Creek formation and that lie on the older Cretaceous sediments in the deeper parts of the basin. It overlaps the Paleozoic rocks in the Crowleys Ridge area. In this report (Ripley) in parentheses is used with McNairy because drillers, ground water engineers, and others have used the term Ripley synonymously with the McNairy sand member. It is, therefore, thought to be inadvisable to drop the name Ripley entirely, but rather to use it thus: McNairy (Ripley). McQueen and others (1939, pp. 50-76) made several divisions in the McNairy which, though present at the outcrop area, cannot be traced very far in the subsurface, especially in rotary drill cuttings and, therefore, are not used in this report. In the outcrop area the McNairy formation is essentially a series of nonmarine micaceous sand, quartzite, sandy clay, and clay. Southeastward toward the deeper parts of the embayment in the subsurface, these beds change in character with the appearance of calcareous material, glauconite, and microfossil fragments. The quartzite phase is absent in the deeper part of the embayment. Staurolite and kyanite are common accessory minerals in the McNairy (Ripley) sand.

Owl Creek formation.—The Owl Creek has been noted in all of the wells from which samples were saved and which penetrated the Cretaceous sediments in the lowland area south and east of Crowleys Ridge. It is known in outcrops and auger borings in the Bloomfield Hills and Benton Hills. The formation in all probability overlapped much of the McNairy (Ripley) in Cretaceous time, but was largely removed during the pre-Tertiary erosion interval. In the Strake well (log No. 1, Pemiscot County) the entire Owl Creek formation was cored. An examination of the core showed the Owl Creek to consist of five feet of brown, calcareous, sandy clay with pyritized fossils and glauconite which had altered from green to brown in color. Fossils found in this sandy clay were identified by Dr. L. W. Stephenson of the United States Geological Survey as Owl Creek forms (see log No. 1, Pemiscot

County). In other deep wells in the lowland area, the poor samples from rotary drilling suggest a similar lithology.

CENOZOIC ERA

Tertiary System

PALEOCENE SERIES

Midway Group

The term "Midway" was originally applied by E. A. Smith (1886, pp. 7-14) to exposures of limestone and marl of basal Cenozoic age that crop out at Midway Landing on the Alabama River, Wilcox County, Alabama. Later G. D. Harris (1894, pp. 303-304) proposed a redefinition to include all the strata between the Wilcox above and the Cretaceous below. This later usage has been generally accepted and is used in this report.

The United States Geological Survey has adopted the designation Paleocene series and has included the Midway group of the Gulf Coast section in that series (Stephenson, 1942). In accordance, the Midway group has been dropped from the basal Eocene.

Presence of beds of Midway age in southeastern Missouri was first mentioned by E. M. Shepard (1907, pp. 24-29) and later positively identified by E. W. Berry (1922, pp. 75-76) from an examination of fossils from an oil test drilled by the Frisco Oil and Gas Company (log No. 2, Dunklin County). More recently, fossils collected by F. E. Matthes near Ardeola, Stoddard County, have been shown to be of Midway age by L. W. Stephenson (Matthes, 1933, pp. 1003-1009). The Cretaceous-Tertiary contact was cored in the Strake well (log No. 1, Pemiscot County).

Clayton formation.—Faunal collections from the Clayton formation in southeastern Missouri have been identified by Dr. Julia Gardner and others of the United States Geological Survey and have been listed by Farrar (1935, pp. 21-22). On the basis of these fossils the Missouri beds have been shown to be of lower Midway age and to be correlative with the Clayton formation of Tennessee, Mississippi, and Alabama.

In the subsurface of southeastern Missouri, the Clayton is one of the most readily recognizable formations. The formation may consist of very glauconitic sand and clay, calcite, and calcareous fossil fragments of gastropods and pelecypods. In the deeper parts of the embayment the Clayton becomes increasingly calcareous; finally becoming a hard, fossiliferous, glauconitic limestone. Because of this hardness, well drillers readily note its presence and often refer to it as the "Cap rock". The limestone phase shows up very well in electrical and drilling time logs. For these reasons it is a good mapping datum. The drilling time change is most pronounced when the base of the Clayton is pene-

trated, therefore, it is desirable to prepare contour maps on the base of the Clayton rather than the top of the Cretaceous (plate V).

Porters Creek formation.—This formation known for many years as the "Flatwoods clay" was named by E. N. Hilgard (1860, pp. 110-111) and placed by him at the base of the so-called "Northern Lignitic formation". Later J. M. Safford (1864, pp. 361-368) renamed it Porters Creek from the type locality on Porters Creek near Middletown, Tennessee. Northward from Tennessee the Porters Creek clay forms a more or less continuous belt of outcrops through Kentucky (Jillson, 1929) and Illinois into Missouri (Lamar, 1928).

The presence of this formation in Missouri was first suggested by E. M. Shepard (1907, pp. 24-29) in the Himmelberger-Harrison well at Morehouse (log No. 1, New Madrid County). It was first recognized on the outcrop by F. E. Matthes (1933, pp. 1003-1009) although J. E. Lamar and A. H. Sutton (1930, pp. 845-866) had previously suggested its presence near the towns of Bloomfield and Idalia, Stoddard County.

The Porters Creek consists in the main of hard, dark gray clay which becomes almost black when completely saturated with water. When it is thoroughly dry it assumes a light gray or cream shade and "spalls off" with a conchoidal fracture. On the outcrop where the clay is well bedded it may contain a considerable amount of fine white sand and mica flakes along the parting planes. This sand is absent in the subsurface in the deeper part of the embayment. Unidentified foraminifera and small pelecypods are common in the lower 50 feet of the formation in the subsurface. Basinward thickening of the Porters Creek is shown in plate VII.

The Porters Creek underlies all of southeastern Missouri south and east of Crowleys Ridge. It crops out in the north-central part of the Bloomfield Hills and along the southern margin of the Benton Hills. Nodules of very impure iron carbonate are present in the upper part of the formation. Bauxitic clay is present at the top of the formation in Stoddard County (Stewart, et al., 1943). No formation in the Mesozoic-Cenozoic section of the Mississippi Embayment is as uniform in lithology as the Porters Creek clay. The contact between the Porters Creek clay and the underlying Clayton is gradational and the exact line of separation is not everywhere distinct. The Porters Creek clay has a distinctive pattern of low resistivity in electrical well logs. Drillers' records indicate extremely slow drilling time in the formation. The drillers report this as being due to "toughness" rather than "hardness". This characteristic together with its electrical log pattern and its uniform lithology makes the Porters Creek formation one of the most distinctive in the Mesozoic-Cenozoic section. On the basis of its lithology, stratigraphic position, and the Midway fossils which were taken from the Frisco oil and gas test

(log No. 2, Dunklin County) and examined by E. W. Berry (1922, pp. 75-76), this formation is correlated with the Porters Creek formation in Tennessee.

EOCENE SERIES

Wilcox group

Various names have been used for this group of sediments. In 1856 J. M. Safford (1856, pp. 148-162) first described these beds in Tennessee under the term "Orange Sand". Later E. W. Hilgard (1860, pp. 110-111) used the name "Northern Lignitic" in Mississippi. In 1869 J. M. Safford (1869, p. 424) revised his earlier description and used the name "Orange Sand or Lagrange Group". The term "Lagrange formation" became widely used in the northern part of the Mississippi embayment and was used in published reports as recently as 1930 by J. E. Lamar and A. H. Sutton (1930, pp. 845-866).

The name Wilcox was first used in published reports by A. F. Crider (1906) who then considered this group as a single formation. However, the term was originally used by E. A. Smith, prior to the above date, in unpublished work done in Alabama. Later the United States Geological Survey (Wilmarth, 1938) raised the name to the rank of a group and included in it all formations lying above the Midway and below the Claiborne. In Mississippi, the Wilcox group included in ascending order the following formations: Ackerman, Holly Springs, Bashi, and Grenada-Hatchegibee. In Tennessee, according to F. G. Wells (1933) only the Holly Springs and Grenada formations are present at the outcrop, but he suggests that the Ackerman may be present in the subsurface. In Kentucky, W. R. Jillson (1929) recognized the presence of the Holly Springs and Grenada formations. J. E. Lamar and A. H. Sutton (1930, pp. 845-866) note the presence of strata of Wilcox age in southern Illinois. Wilcox sediments have long been recognized in northeastern Arkansas, but have never been subdivided (Stephenson and Crider, 1916). The term Wilcox was first used in Missouri by M. E. Wilson (1922, pp. 263-264) to include all strata between the Cretaceous below and the Pliocene (?) gravel above. More recently F. E. Matthes (1933, pp. 1003-1009) in referring to these beds in Missouri used the name Wilcox in the same sense. In 1935 W. Farrar redefined the Missouri usage of the term to include only those beds of sand and clay that lie between the top of the Midway and the base of the Pliocene (?). This redefinition conforms with the usually accepted meaning of the Wilcox group throughout the Coastal Plain region.

Paleontologic proof for the Wilcox age of these beds has been established by R. W. Brown of the United States Geological Survey from an examination of fossil leaf collections (Farrar et al., 1935). These beds in Missouri in the main are nonmarine in origin and, with the exception of plant remains, are unfossiliferous.

The Wilcox group ranges in thickness from a few inches at the outcrop to more than 1300 feet in the subsurface in the extreme southeastern corner of the state. Pronounced unconformities mark the boundaries between Wilcox and the underlying Midway, and between the Wilcox and overlying Pliocene (?).

In the subsurface of the lowland area, the Wilcox consists chiefly of coarse, slightly micaceous sand interbedded with thin lenses of lignite and clay. The sand is ordinarily light in color and well-rounded. The clays vary in color from brown through shades of green and pink. Certain portions of the group contain black chert with the sand. H. S. McQueen (1939, pp. 59-76) published subdivisions proposed by Dan Stewart and Lyle McManamy. The divisions were given formational names such as Ackerman and Holly Springs which are used elsewhere in subdividing the Wilcox group. McQueen's subdivisions were lithologic and had no paleontologic support. Although these divisions may be apparent in the outcrop areas they do not appear to be persistent laterally and could not be recognized by the present writer in the subsurface. For this reason the Wilcox is not subdivided in this report.

Quaternary System

PLIOCENE (?) SERIES

"Lafayette" formation.—W. Farrar (1935) noted the presence of this formation in the embayment area of southeast Missouri. This report follows his usage and includes in the "Lafayette" the gravel and interbedded sand and clay which lie between the top of the Wilcox group and the base of the Pleistocene loess. In the subsurface, identification of the "Lafayette" is based in part on its stratigraphic position. In areas where recent alluvium is the surface formation and the loess is absent, the stratigraphic position of the "Lafayette" if present has not been determined with certainty, therefore, it has not been possible to indicate its presence in many wells.

PLEISTOCENE SERIES

Loess undifferentiated.—In the subsurface, the loess is a buff silt or clay which is remarkably uniform both vertically and laterally. The loess rests unconformably upon an uneven eroded land surface which includes all the formations from the Paleozoic dolomites to the Pliocene (?) gravels. The loess is widespread in the area and blankets Crowleys Ridge. It also is found in much of the southeastern margin of the Ozark province. Stewart (1942) states that "in the vicinity of Commerce, Scott County, a persistent thin bed of gravel occupies a position about midway in the thickness of the exposed loess, and that beneath the thin gravel bed the color of the clay is decidedly more red". Edward L. Clark (personal communication) suggests that this clay bed is most likely

the Loveland loess with Peorian loess above. Farmdale loess occurs in the vicinity of Dexter and Advance (Leighton and Willman, 1950).

RECENT SERIES

Alluvium undifferentiated.—As used in this report, the alluvium represents sediments deposited and reworked by the ancestral and present Mississippi and Ohio Rivers and their tributaries. Differentiation of the alluvium as indicated by Farrar and McManamy (1937) is not feasible in the subsurface. It consists of coarse, poorly sorted, highly arkosic sand. Brown chert fragments are common. Metamorphic and igneous rocks are present as worn pebbles. Gneiss and schist fragments also are found in the alluvium. Toward the base of the alluvium a coarse chert gravel bed is ordinarily present. This gravel bed is usually associated with or is immediately above a coarse, arkosic sand containing lignite. The lignite zone has been found in many wells in the embayment area. The alluvium is in contact with all formations from the Paleozoic to the youngest Tertiary.

STRUCTURE

The subsurface structure of the area is indicated by plates IV, V, VI, and VII. In the Ozark province which is contiguous to the north portion of the embayment area, the dip of the Paleozoic formation is to the south and east and is much less than 1 degree. Contours on the top of the Paleozoic surface southeast of the Ozark Escarpment indicate a similar amount and direction of dip. The angle of dip does not change across the Escarpment in the Paleozoic rocks, as is shown by well No. 2, Bollinger County, and wells No. 2 and No. 11, Stoddard County, on the cross section, plate VII. The Ozark Escarpment has been designated as a fault scarp by some geologists, but the surface and subsurface geology refute such designation.

The top of the Paleozoic, as shown in plate IV, dips to the southeast at an average rate of 35 feet per mile with only minor interruptions in most of the embayment area. The surface of the Paleozoic is beveled and truncated and reflects pre-Cretaceous topography. The structure map of the top of the Paleozoic has been drawn even though it does not represent true structure. Its value is considered greatest for drilling contractors and others who may be interested in estimating the depth of the top of the consolidated Paleozoic rocks. The magnitude of the erosion on the top of the Paleozoic is clearly indicated in Scott County between Chaffee and Oran.

Similarly, in the vicinity of Pascola and Caruthersville, contouring shows that this surface is a topographic low directly over the pre-Cretaceous structural high which is here designated as the Pascola arch. The trend of the Pascola arch is northwestward

from the vicinity of Hayti and the Mississippi River through Pascola and Campbell to Poplar Bluff and the Ozark Escarpment. Along the crest of the structure, formations ranging from Bonneterre to Roubidoux occur immediately beneath the McNairy (Ripley) while on the flanks to the north and south of the axis younger formations ranging from Jefferson City to Smithville (?) are immediately below the McNairy (Ripley). The highest structural area on the Pascola arch is in the vicinity of Caruthersville and Hayti where the Bonneterre formation lies immediately below the McNairy (Ripley). This area is probably one of local doming, although it has been suggested (Freeman, 1949, pp. 1656-1657) that the structure is a nose southeastward from the present Ozark uplift. Subsurface data over the Pascola structure indicate that this structure is post-Jefferson City and pre-Cretaceous in age. Data outside of Missouri indicate a slight pre-Chattanooga rise in southwestern Kentucky toward Pascola, Missouri, (Freeman, 1945, pp. 16, 33). The intrusives encountered by wells on the Pascola arch are very similar petrographically to the post-Devonian intrusives of Ste. Genevieve County (Kidwell, 1947). The movement which formed the Pascola arch was probably associated with the intrusions and with faulting and fracturing of the strata. Fracturing is indicated in the cores from the Strake well which show slickensiding and shearing at a depth of 2338 feet. In the northern periphery of the embayment area, Lower Devonian rocks (Bailey) are found in down-dropped fault blocks and are associated with Silurian and Ordovician rocks. At no place in the area have Mississippian rocks been found. Had they been present, it is reasonable to assume they would have been preserved in the fault grabens, provided the faulting was post-Mississippian. Residual cherts from the Mississippian are not uncommon throughout the Ozark province. Their absence in the embayment area together with the structural preservation of the Devonian is strongly suggestive that the structural deformation was pre-Mississippian and post-Lower Devonian.

Faulting

Some faults have been noted by surface mapping in the area. Faulting in the subsurface is suggested, in the Strake well (log No. 1, Pemiscot County) and the Oliver well (log No. 6, New Madrid County), by the numerous openings or fractures, but actual displacement of strata is not evident in these wells. Faulting is also suggested by logs No's. 1, 21, and 22, Scott County, where McNairy (Ripley) Cretaceous sand was drilled below the Everton dolomite. Description of some of the faults noted in the outcrop is given by Stewart (1942) as follows:

Jenkins Basin Fault:

> This fault which has the largest displacement of any known in the embayment area is in the NE¼ NE¼ NE¼ sec. 28, T.

28 N., R. 11 E., Stoddard County, where it is exposed in the bluffs of the Bloomfield Hills on the west side of Jenkins Basin, 3.25 miles north of Bell City. The trace of this fault is not visible but the attitude of the rocks indicates a general east-west strike. The Bailey (Devonian), the entire Silurian, and post-St. Peter (Ordovician) rocks are down faulted on the south against the Smithville (Canadian) on the north. This fault is probably a graben as 0.25 miles to the south undisturbed Smithville dolomite is found in place. The displacement would seem to be about 1200 feet, by assuming that the displaced formations have their normal thicknesses. The overlying Cretaceous formations do not appear to have been disturbed.

Mouth of Albright Creek Fault:

This fault is exposed in the Mississippi River Bluffs on the south bank of Albright Creek in the SE¼ SW¼ sec. 12, T. 29 N., R. 14 E., Scott County, or 2.25 miles north of the town of Commerce. The Bailey (Devonian) and Bainbridge (Silurian) are down thrown to the southeast against the Thebes (Ordovician). The fault plane is vertical and strikes N. 22° E. The displacement is probably 400 feet. This fault is also described and illustrated by a sketch by McQueen and others (1939, pp. 59-76).

"Chalk Bluff" Fault:

This fault is exposed in the bluffs of the Mississippi River in the SE¼ SE¼ sec. 13, T. 29 N., R. 14 E., Scott County, at a point known locally as the "Chalk Bluff", or 1.25 miles north of the town of Commerce. The Bailey (Devonian) formation is down thrown to the southeast against the Thebes (Ordovician) with no Silurian exposed. The tripolitic nature of the Bailey cherts at this exposure accounts for the name "Chalk Bluff", as school children formerly used pieces of the rock for black board chalk. The displacement along this fault is equal to the thickness of the Silurian rocks plus the involved Bailey (Devonian) or about 450 feet. This structure is also described and illustrated by a sketch, McQueen and others (1939, pp. 33-73).

Idalia Hill Fault:

This fault, or series of faults, is exposed in the road ditches on both sides of Stoddard County Highway E on a hillside in the NE¼ SE¼ NE¼ sec. 28, T. 26 N., R. 11 E., 0.5 miles north of the town of Idalia, Stoddard County. This structure is a series of closely spaced parallel faults striking N. 50° - 60° E. that have produced alternating up thrown and down thrown blocks. Some of these blocks are no more than 3 feet across. The strata involved include the upper part of the Porters Creek; a clay in the lower part of the Wilcox and the Pliocene (?) gravels. Auger drilling revealed the displacement along the fault planes to range from 50 to 100 feet.

English Hill Fault:

This fault is exposed about half way up the hillside on the English Hill road which joins the Commerce-Benton road 4.0 miles southwest of the town of Commerce, or in the SW¼ SW¼ NW¼ sec. 34, T. 29 N., R. 14 E., Scott County. The loess is down faulted against a sand in the basal Wilcox in the form of a graben

which strikes N. 30° E.; the displacement is probably not greater than 30 feet. This fault lies along the strike between the "Mouth of Albright Creek fault" and the "Idalia Hill fault" and is probably a part of these structures.

Beech Grove Branch Faulting and Folding:

This structure which is along the strike of the last two faults discussed is exposed in the bed of Beech Grove Branch in the NE¼ SE¼ sec. 9, T. 26 N., R. 11 E., 5.0 miles northeast of the town of Bloomfield, Stoddard County. The Porters Creek clay and the lower Wilcox sand and clay are involved in a series of folds and block faults striking from N. 50° W. to N. 30° E. The displacement is quite small; between 10 and 20 feet.

Poplar Branch Faulting and Folding:

The Poplar Branch structure is exposed in the bed of the branch of that name in the NE¼ NW¼ sec. 9, T. 26 N., R. 11 E., or about 5.5 miles northeast of the town of Bloomfield, Stoddard County. The structure as seen in the bed of the branch extends for about 0.5 miles along the Porters Creek—basal Wilcox contact and consists of a series of folds and fault blocks that vary in strike from N. 55° W., N. 30° W. to N. and S., with dips on the folds ranging upward to 40 degrees. The displacement and relief of these structures range from 10 to 20 feet.

Folding

Stewart and McManamy (1944) have described an unusually, highly folded area just north of the town of Commerce, Scott County. The area lies in the SW¼ sec. 19, T. 29 N., R. 15 E., and in the SE¼ sec. 24, T. 29 N., R. 14 E. The faulting and folding were determined during surface mapping and were checked in part by auger drilling where outcrops were scarce or non-existent. The relief of the folding at one place averaged about 150 feet with the distance between the crests of two anticlines being approximately 600 feet. The deformation was post-"Lafayette" and pre-loess. Because of the absence of specific age of the "Lafayette" gravel, the movement can only be dated as occurring in either late Tertiary or early Quaternary time.

ECONOMIC GEOLOGY

The embayment area contains small deposits of clay in Crowleys Ridge which have been used locally for the manufacture of pottery, tile, and stoneware. Bleaching earth or fullers earth, though present in enormous tonnages in the Porters Creek, has never been mined or commercialized in the area. Ground water, high-calcium limestone, dolomite, sand, gravel, and iron ore are other important mineral resources of the area.

Sand and Gravel

Sand.—Sand has been produced from open pits in the Wilcox and McNairy (Ripley) formations at various places in Crow-

leys Ridge; especially in Scott and Stoddard Counties. The sand of the Wilcox formation is loose and unconsolidated, is usually mixed with clay, and varies from 0.6 to 27 percent in dirt. The coarser sand particles are subangular to well rounded and the finer sand particles are subangular to sharp. The sand of the McNairy (Ripley) in the vicinity of Commerce in Scott County varies from a loose, friable sandstone to a vitreous quartzite. The grains are well rounded, moderately fine, and buff to pink in color. Most of this sand, though sufficiently friable at places, is too impure to serve as glass sand. It is also too fine for satisfactory structural sand.

Gravel.—The gravels attain their greatest thickness and maximum development on the hilltops along the southeastern margin of Crowleys Ridge. Along this belt, which extends from Commerce to Morley in the Benton Hills and from Guam to Dexter in the Bloomfield Hills, the gravels are found in contact with the underlying Wilcox sediments at altitudes ranging from 500 to 600 feet. The base of the gravels dips away from this area of maximum development northwestward toward the Ozark province and southwestward toward Campbell. The gravels represent a wide assortment of material, but in general they consist of 80 or 90 percent of brown chert pebbles and from 10 to 20 percent of quartz and quartzite pebbles. The gravels are all water worn and more or less rounded, and average between 1.5 inches to 3.0 inches in diameter. The sand associated with the gravels is medium to coarse grained in size and is highly iron stained giving the entire mass a dark red color, hence, the local name "red gravel" for such material. The clay, which occurs rather erratically as thin lenses or clay balls, varies in color from white, gray, yellow, and lavender to deep red. When considerable clay and sand are present with the gravels, the gravels require washing before being used in concrete. Because of the presence of clay and sand impurities, most of the gravel is used locally for road metal.

Farrar and McManamy (1937, p. 64) list the locations of the larger gravel pits as follows:

SE¼ NW¼ sec. 29, T. 28 N., R. 11 E.
NE¼ sec. 30, T. 28 N., R. 11 E.
NE¼ SW¼ sec. 34, T. 28 N., R. 11 E.
Southern part of sec. 4, T. 27 N., R. 11 E.
Common corner of secs. 16 and 17, 20 and 21, T. 27 N., R. 11 E.
SW¼ sec. 2, T. 26 N., R. 10 E.
N½ sec. 11, T. 26 N., R. 10 E.
NE¼ sec. 21, T. 26 N., R. 10 E.
NW¼ sec. 5, T. 26 N., R. 11 E.
NE¼ SW¼ sec. 31, T. 26 N., R. 11 E.
NW¼ SE¼ sec. 11, T. 25 N., R. 10 E.
NE¼ NE¼ sec. 16, T. 25 N., R. 10 E.
SE¼ NE¼ sec. 17, T. 25 N., R. 10 E.
NW¼ SE¼ sec. 33, T. 25 N., R. 10 E.
SW¼ sec. 31, T. 27 N., R. 10 E.

SE¼ sec. 13, T. 26 N., R. 8 E.
NE¼ sec. 6, T. 25 N., R. 10 E.
Common boundary of SE¼ sec. 25 and NE¼ sec. 36 T. 25 N., R. 9 E.
SW¼ SW¼ sec. 17, T. 24 N., R. 10 E.
Near center of the east line of sec. 1, T. 27 N., R. 9 E.

Clay

Pottery clay.—Lenses of pottery, tile, and stoneware clays occur in the Wilcox group and in the Owl Creek and McNairy (Ripley) formations. Farrar and McManamy (1937, p. 51) give a discussion of the various clay localities, the types of clay, and their uses. The Evans Brothers pottery, situated on Highway 25 about 3 miles north of Dexter, Stoddard County, was probably the oldest one in the area. Several different types of ware were produced in this pottery; brown stoneware, bean pots, crocks, and pitchers, all of which were covered with Albany slip glaze. Unglazed flower pots with a roughened, and in some cases molded outer surface, were produced in quantity. Vases and bowls with Albany slip and with the outer surface displaying brown, red, cream, and blue stripes were a large item in the tourist trade. The Wilcox clays used in the Evans Brothers pottery are obtained a few miles north of Dexter in secs. 11, 12, and 14, T. 25 N., R. 10 E. Farrar and McManamy (1937, p. 52) also state that a large deposit of Wilcox clay is present in secs. 14, 15, 22, and 23, T. 26 N., R. 11 E., about 2 miles northeast of the village of Idalia. They believed that this clay was probably superior to the other Wilcox clays found in Stoddard County.

Sewer pipe clay.—Clays found in the Owl Creek formation have been used in the manufacture of sewer pipe and tile. The Post Brothers Brick and Tile Company mined clay for these products in both Scott and Stoddard Counties. In Scott County they mined clay near Commerce in the NE¼ SE¼ sec. 26, T. 29 N., R. 14 E. The Post Brothers Brick and Tile Company also mined clay for their use in sec. 23, T. 26 N., R. 11 E., near Idalia, in Stoddard County. Clay suitable for pottery bodies, tile, or stoneware may be found in secs. 14, 15, and 23, T. 26 N., R. 11 E., and in sec. 14, T. 25 N., R. 10 E. (Farrar, 1935, p. 31).

Iron Ore

Limonite, commonly designated as brown iron ore, has been mined in the area along the southeastern margin of the Ozark province extending from the vicinity of Cape Girardeau to the southern boundary of Ripley County. Southeast of the Ozark Escarpment, some primary limonite has been mined, chiefly in Stoddard County. Crane (1912, p. 54) classified the limonites as primary and secondary with the primary ore being precipitated directly from solution as hydrous ferric oxide, and the

secondary ore being derived through the oxidation and hydration of marcasite and pyrite. The primary ores do not contain marcasite and pyrite, but these minerals are present in some of the boulders of secondary limonite and they are commonly found in the lower portion of secondary limonite deposits. Only in exceptional cases does the secondary ore contain over 0.2 percent sulphur and occasionally the secondary ore will contain as low as 0.05 percent. Analyses of 105 shipments from 10 mines (Crane, 1912, p. 61) show the following composition for the secondary ore: 52.98 percent iron, 10.40 percent silica, 0.091 percent phosphorous, and 0.133 percent manganese. The primary ores contain an excess of silica and are not acceptable to the blast furnace unless special treatment is given them to eliminate this impurity. Analyses of 10 shipments from the Pico Mine near Puxico, Stoddard County, showed the following composition (Crane, 1912, p. 71): 48.00 percent iron, 16.59 percent silica, 0.041 percent phosphorous, 0.77 percent manganese, and 3.38 percent moisture. The average analyses of primary limonite from 11 mines showed the following (Crane, 1912, p. 71): 46.21 percent iron, 16.48 percent silica, 0.068 percent phosphorous, 1.319 percent manganese, and 3.59 percent moisture. Even such special treatment as washing and jigging does not lower the silica content sufficiently to render the ore suitable for present day blast furnace specifications. This is due in part to the intimate association of the silica and iron. The silica may be present either as chert which has been partially replaced by iron or as quartz sand in a limonite matrix.

Ground Water

As used in this report, ground water is that water which is present beneath the land surface. In the lowland area, the various sands of the Cenozoic and Mesozoic are capable of yielding very large amounts of potable water for municipal, private, domestic, industrial, and agricultural use. McNairy (Ripley) sands are the source of an unusually soft water (for Missouri) which is also very low in iron content.

Aquifers or waterbearing strata.—Well water supplies are obtained from four aquifers in the area as follows in order from the surface downward:

1. Alluvial sands and gravels.
2. Wilcox sands.
3. McNairy (Ripley) sands.
4. Paleozoic dolomites and sandstones.

Chemical composition of ground waters.—In the discussion of ground water supplies from the various acquifers, the writer has used such terms as "low-iron", "soft", and "fresh". In order to compare the various waters more specifically, it is necessary to

refer to their chemical analyses (tables 1 to 5) and then to compare these with accepted standards, such as those of the United States Public Health Service. These standards are as follows:

Iron (Fe) and manganese (Mn) together should not exceed 0.3 ppm (parts per million). Iron if present in amounts greater than 0.3 ppm is almost certain to precipitate and form red stains. Manganese, if present in amounts greater than 0.1 ppm will usually precipitate and form black or brown stains.

Chloride (cl) should not exceed 250 ppm. Chloride unites with sodium (Na) to form common salt. Chloride in excess of 300 to 500 ppm is salty to the taste for most persons. Livestock can tolerate much higher concentrations of chloride.

Magnesium (Mg) should not exceed 125 ppm.

Sulphate (SO4) should not exceed 250 ppm.

Magnesium and sulphate when combined are Epsom salt, and water containing an excess of magnesium sulphate will have noticeable laxative effects.

Hardness is a term used variously, depending upon the locality; water said to be hard at some places might be considered soft at others. Two kinds of hardness are usually shown by chemical analyses; non-carbonate and carbonate. The first is called permanent hardness and the second is identified as temporary hardness by many people. Non-carbonate hardness is usually due to the sulphates and chlorides of calcium and magnesium. Carbonate hardness is caused mainly by the bicarbonates of calcium and magnesium. Ranges of hardness or softness may be classified as follows:

0 to 15 ppm. is extremely soft.
15 to 30 ppm. is a very soft.
30 to 45 ppm. is soft.
45 to 90 ppm. is moderately soft.
90 to 110 ppm. is moderately hard.
110 to 130 ppm. is hard.
130 to 170 ppm. is very hard.
170 to 230 ppm. is excessively hard.

It is usually economical to soften water when the hardness is as much as 125 to 150 ppm. For municipal purposes softening is ordinarily not practiced when the water hardness is below 70 ppm.

Alluvial water supplies.—Private and domestic water supplies are obtained in the lowland areas from the alluvial sands and gravels by driven wells which range in depth from 15 to 50 feet. A drive point is fastened to the end of a strainer which is attached to a pipe, and this is driven into the ground. When the strainer is below the water table a suction "pitcher" pump is installed and the well is pumped until all the fine sand and clay has been washed out of the sand surrounding the strainer. Driven wells are very cheap and simple to complete. When large yields of water are

required, alluvial wells are drilled so as to completely penetrate the coarser gravels which are usually present in the lower portion of the alluvium. Most of these large yield wells range from 150 to 200 feet in depth and are completed with casing extending from the ground surface to the top of the gravel. A screen is attached to the casing and is set opposite the coarse zones of sand and gravel. The diameter of the screens and casing varies with the wells, with 10 inch casing and screen being the most preferred size.

Wells of this type, with yields of from 250 to 500 g.p.m., are not uncommon in the lowlands. Farrar and McManamy (1937, p. 68) report that an alluvial well near Dudley in Stoddard County produced 1600 g.p.m. from a depth of 152 feet. An alluvial sand well drilled for O. H. Acom of Wardell in sec. 28, T. 20 N., R. 12 E., to a depth of 112 feet was tested at a rate of 4200 g.p.m., and the water level stood 2 feet below ground level when the pump was idle. The production from the various alluvial wells shown in table 1 ranges from 250 to 500 g.p.m. It will be noted from this table that the iron content of the alluvial water is considerably higher than that of either the Wilcox or McNairy (Ripley) water. Because of this iron content alluvial wells, though shallow and relatively cheap to complete, are not regarded as very desirable for domestic and municipal supply. However, irrigation wells in the alluvium are becoming increasingly numerous in the area.

Wilcox water supplies.—The sands of the Wilcox group have been used as a source of water supply in much of the embayment area, especially in the lowlands to the southeast of Crowleys Ridge. Typical wells along with pertinent water data are given in table 7.

Comparison of table 6 with table 7 shows that the water level in the Wilcox wells does not rise as high in altitude as does the water level in the McNairy (Ripley) wells and that none of the Wilcox wells flow above ground surface. However, when the wells are pumped at rates in excess of 150 g.p.m., the water level in the Wilcox wells is shallower than the water level in the McNairy (Ripley) wells; this results in a shallower pump setting. Wells in these sands are drilled with rotary equipment and no perforated casing is ordinarily used in Wilcox wells, and the screen is usually set in open hole opposite the best sand. Even though Wilcox wells can be completed at less cost, McNairy (Ripley) wells are more highly desired because they ordinarily flow above the ground surface if properly situated and developed. This together with the soft nature and low iron content of the McNairy (Ripley) water has made the McNairy (Ripley) one of the most widely developed aquifers in the embayment area. Wilcox water in general is harder and higher in iron content than the water from the McNairy (Ripley) although there are exceptions to this generalization; see tables 2 and 3.

McNairy (Ripley) water supplies.—The sands of the McNairy (Ripley) are also used as a source of municipal water supply in the embayment area. Wells producing from this formation along with pertinent water data are given in table 6.

The depth of these wells ranges from 286 feet at Bloomfield, Stoddard County, to 2153 feet at Hayti in Pemiscot County. It is evident that the altitude of the water level in these wells ranges from not less than 310 feet to a maximum of 350 feet. Most of the wells flow at ground level; the only exception to this is the Bloomfield well which has an altitude of 458 feet. It appears that any McNairy (Ripley) well in the area will flow at ground level provided that the well is situated southeast of Crowleys Ridge, that the altitude of the land surface at the well site is less than 300 feet, that no unforeseen limiting factors develop in the subsurface, and that the well is not improperly drilled and constructed (table 6). Most of the McNairy (Ripley) wells yield water that is very soft and low in iron content (see table 3). This type of water is the most desirable in the area. The temperature of the McNairy (Ripley) water increases with the depth of the sands as is shown by the chart (figure 2) which indicates a range in temperature from a minimum of 60° F. at Bloomfield in Stoddard County to a maximum of 94° F. at Hayti in Pemiscot County; the geothermal gradient is 1° F. to each 57.8 feet of depth.

McNairy (Ripley) wells are usually drilled with rotary equipment through the main body of sand. To develop a maximum water supply, the casing is set at the top of the sand body and a screen, attached to the casing, is set opposite the thickest and most porous sands. Some drillers change from rotary to cable-tool rigs when the top of the sand body is reached and "drill in" with cable-tools. When this is done, it is common practice to set perforated casing through the sand body and place the screen opposite the best sands inside the perforated casing. In either method it is important that the proper size screen be used and care be exercised to set it opposite the best sand for best results. To determine the best water bearing sand zones, it may be advantageous to make an electric log of the sand body and compare this with the drilling time which should be recorded by the driller. Wells, in which the McNairy (Ripley) is interbedded sand and shale, may be affected by having the sand and shale flow with the water if the wells are not constructed so as to prevent such an unsatisfactory condition. The McNairy (Ripley) offers a source of supply for textile and similar industries which require a soft water with a low iron content.

Paleozoic water supplies.—Paleozoic supplies of fresh water have been obtained in the northern and western portion of Crowleys Ridge, and especially where the Paleozoic rocks are at the surface. Municipal supplies are obtained from Paleozoic rocks at Benton, Chaffee, Fornfelt, Illmo, and Puxico on Crowleys Ridge.

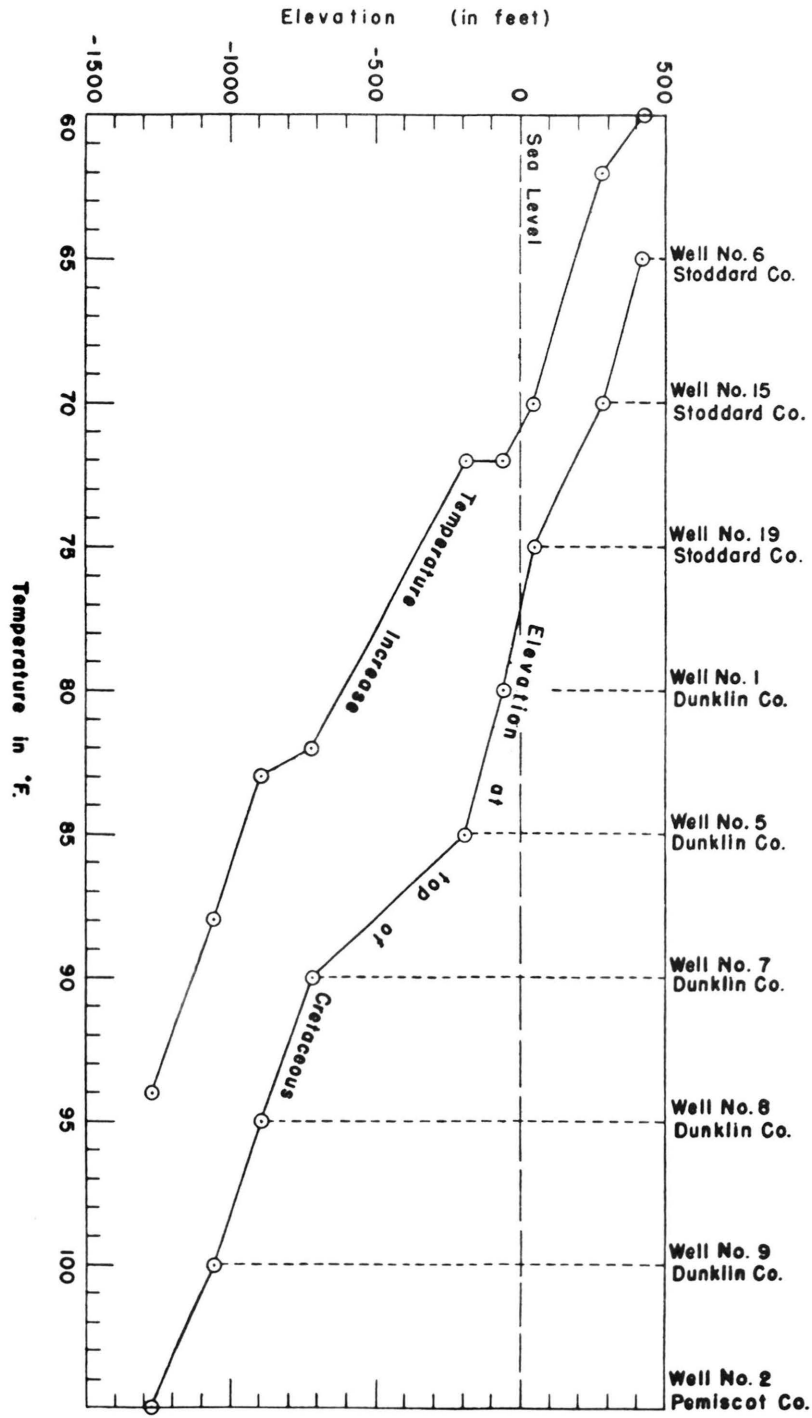

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Chart Showing Increase in Temperature of Ripley Water With Depth

FIG. 2

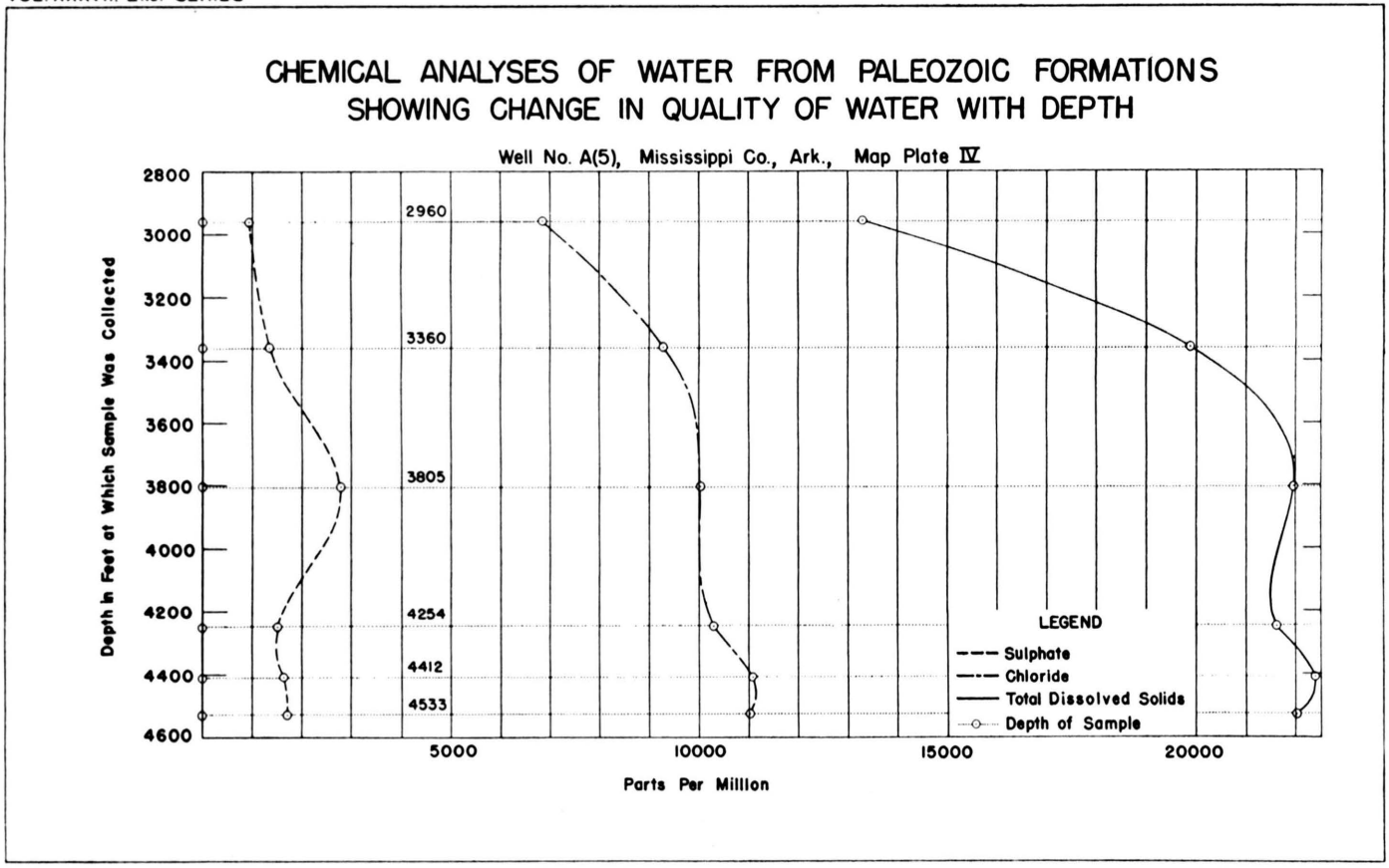
Production data for these wells are given with their logs which are included in this report.

No water supplies of consequence have been developed from Paleozoic rocks to the southeast of Crowleys Ridge. This is probably due to the excessive depth of these rocks in that area and to the fact that bountiful supplies of fresh water are obtained from the overlying sands and alluvium. The probability is that water from the Paleozoic rocks to the southeast of Crowleys Ridge will be sulpho-saline (see chemical analysis number 1934, well no. 4, table 4). Paleozoic water in the U. S. Bureau of Mines test (log No. 6, New Madrid County) had an odor of hydrogen sulphide ("sulphur"). Because of the large amount of sealing compounds used to regain lost circulation in this well, there was too much suspended matter to obtain a satisfactory chemical analysis. Paleozoic water in the Benedum Trees test (log No. A5, Mississippi County, Arkansas) was sulpho-saline and became increasingly mineralized with depth (table 5 and figure 3). Thus it would appear that mineralization of Paleozoic water increases downdip and with depth. This condition is known to prevail in wells on other flanks of the Ozark uplift.

In the Ozark province near the Ozark Escarpment, the Paleozoic rocks furnish relatively large quantities of fresh water at Poplar Bluff and in the vicinity of the city of Cape Girardeau. At the latter place, the St. Peter sandstone yields approximately 50 g.p.m. of fresh water. To the west of the St. Peter outcrop area (plate II), older Paleozoic rocks such as the Gasconade, Eminence, and Potosi dolomites yield from 50 to 300 g.p.m. of fresh water. The yield from any particular well will depend upon the porosity of these dolomites and the number and size of openings encountered therein, therefore, yields cannot be predicted in advance of drilling any particular well, although generalizations may be possible from information obtained in nearby wells. At places where the Roubidoux is the surface formation and erosion has cut into the underlying Gasconade formation, the Roubidoux may be highly dissolved or leached and may consist of residual boulders and red clay. In such places, it is usually advisable to drill the well several hundred feet into the underlying Gasconade dolomite and case off the leached Roubidoux to eliminate mud-filled openings. Such a practice rarely eliminates much water.

Oil and Gas Possibilities

The embayment area of southeast Missouri possesses some striking surficial resemblances to other parts of the Gulf Coastal Plain in which oil and gas are produced. Physiographic features such as Crowleys Ridge and Sikeston Ridge (plate VIII) have been mistakenly presumed to be of structural rather than of erosional origin. Reported "shows" of oil or gas in some test holes have been a stimulus to persons in search of oil or gas who see a


CHEMICAL ANALYSES OF WATER FROM PALEOZOIC FORMATIONS
SHOWING CHANGE IN QUALITY OF WATER WITH DEPTH
Well No. A(5), Mississippi Co., Ark., Map Plate IV
Depth in Feet at Which Sample Was Collected
2800
3000
3200
3400
3600
3800
4000
4200
4400
4600
2960
3360
3805
4254
4412
4533
5000
10000
15000
20000
Parts Per Million
LEGEND
Sulphate
Chloride
Total Dissolved Solids
Depth of Sample

resemblance of the surface features of this area to the areas with which they are familiar and in which oil or gas are produced.

A lack of geologic information has retarded orderly exploration and has resulted in poor locations for some of the tests drilled. Until much more detailed information is available, it will be difficult to designate any portion of the area as being more favorable than another for drilling test holes for oil or gas. The available data do not permit completing those portions of plate III which lie along the Mississippi River between East Prairie and Commerce in Mississippi and Scott Counties respectively, although this area may have in the subsurface certain formations which are productive in Illinois. The structure maps (plates IV to VI) do not indicated the presence or absence of local structural features and are only indicative of the regional structure. This writer has been unable to correlate his structure maps with the magnetic map of McQueen (1940). The large magnetic anomalies shown by McQueen's map may be due in part to changes within the pre-Cambrian "basement" rocks. The magnetic anomaly between Malden and Gideon is now known, as a result of additional magnetic surveys, to be different than shown by McQueen's magnetic map in that the anomaly is a simple magnetic "high" which does not possess the unusual magnetic "lows" as shown by his map.

At least 15 tests have been drilled in the search for oil and gas in the embayment area of southeast Missouri and there have been others drilled in adjoining states. Drillers logs of some of these holes include reported "shows of oil", and are incorporated in the logs published herewith. Many of these reported "shows" have not been authenticated by other evidence. In the Benedum Trees test, drilled about 3 miles south of the Missouri State Line in Mississippi County, Arkansas, (log No. A5) black, very viscous, *asphaltic* or *petroliferous* material with the consistency of petrolatum occurred in the Gasconade and Eminence formations from depths of 3721 feet to 4525 feet. These formations are an equivalent of a portion of the Ellenburger from which oil is produced in west Texas. Similiar material occurred in the Tennark test which was drilled at Jonesboro, Arkansas, some 50 miles southwest of the Benedum Trees test. In the Tennark test, the black viscous material occurred in a porous dolomite of Paleozoic age at depths from 2700 feet to 2734 feet, or 1000 feet below the Paleozoic and Mesozoic (Cretaceous) unconformity. The Tennark material was analyzed by a chemist of a major oil company and was reported by him to be "a naturally occurring mixture of hydrocarbons"; casual inspection by some petroleum geologists had previously resulted in the opinion that the material was "machine grease". Petroliferous material is known to be present in the Bonneterre dolomite in the vicinity of Fredericktown, Madison County, Missouri, where the petroliferous matter is found in vugs in the host rock of the lead ores.

The Bonneterre formation in the Strake well (log No. 1, Pemiscot County) consisted in the main of black carbonaceous shale from a depth of 3070 feet to 4510 feet. Bonneterre black shale was drilled from a depth of 2712 feet to 3345 feet in the Killam well (log No. 6, Pemiscot County). The presence of petroliferous material and the black shale in the Bonneterre formation indicates to this writer that source beds for oil or gas are present in the Paleozoic rocks of the area.

The various Pennsylvanian and Chester producing formations of Illinois are not known in the area. Devonian formations are present in the northeast portion of the area, but are patchy in distribution. The Kimmswick or "Trenton" which produces oil in Illinois crops out in the northeastern portion of the area where it contains fresh water. To the south and east of Crowleys Ridge, the McNairy (Ripley) which is equivalent to the Nacatoch of Arkansas is widespread and produces fresh water throughout most of the area.

Of particular interest is the asphalt which was found in the city of Hornersville No. 2 well (log No. 9, Dunklin County). When this well was first completed in April, 1946, the water rose 81 feet above ground level and the flow was estimated at 150-200 g.p.m. of fresh water which was similar in composition to the waters listed in table 3. Some time after 1946, it was noted that the flow of the Hornersville well was markedly decreasing. In the latter part of 1950, D. F. Weldon, the original driller, reconditioned the well and removed the metal screen which had been set opposite the McNairy (Ripley) formation at depths of 1796 to 1846 feet and from which the water was being derived. An inspection of the 50 foot screen revealed it to be almost completely sealed with a black viscous substance which upon removal could be formed into balls that retained their shape at room temperature, even after the material was removed from the well for several days. The temperature of the water from the well was 88 degrees Fahrenheit. Samples of the material were analyzed by Professor Magill, head of the Department of Chemistry at State College, Cape Girardeau, Missouri, and pronounced by him to be almost pure asphalt (Cape Girardeau Southeast Missourian, 1950). Additional samples of this material were submitted by Mr. D. F. Weldon to the Missouri Geological Survey in January of 1951 for further analysis. These samples were analyzed by Harold M. Smith of the U. S. Bureau of Mines at Bartlesville, Oklahoma, who reported "inasmuch as no saponifiable material was found to be present, it is concluded on the basis of the present data that the bitumen is more or less a typically asphaltic type containing 1.25 weight per cent sulphur and having solubilities in hexane and benzene typical of that found for asphalts" (letter to Edward L. Clark, 1951).

Even though no oil has been noted in the McNairy (Ripley) in southeastern Missouri, asphalt found in this formation in the city of Hornersville No. 2 well is of interest to the petroleum geol-

ogist, despite the fact that the asphalt was too viscous to pump from the well.

The McNairy (Ripley) might be considered a good reservoir in most of the area, but the McNairy (Ripley) produces fresh water throughout the area. No valid shows of oil or gas are known in the Wilcox in this area.

Beds equivalent to the "Knox" which produces oil in Kentucky and Tennessee are represented by the Canadian and Ozarkian formations (of E. O. Ulrich). No shows of oil have been noted in well cuttings from these formations in this area. The Ozarkian formations are very porous as shown by the large amount of water found by the Strake well and the U. S. Bureau of Mines test in these formations. The Canadian formations also contain water in the area, but are not nearly as porous as the Ozarkian formations. The Canadian and Ozarkian formations are equivalent to parts of the "Arbuckle" from which oil is produced in the Mid-Continent region and to parts of the Ellenburger from which oil is produced in West Texas. As previously mentioned, the Canadian and Ozarkian formations to the south and east of Crowleys Ridge yield sulpho-saline water.

The most prominent subsurface structure in the area is the Pascola arch. This structure has been tested by two wells (both dry); the Strake well and the Killam well. The Strake well was bottomed in a quartzite which may be equivalent to the Lamotte sandstone. The Lamotte in most of the Ozark region rests upon pre-Cambrian igneous rocks. The quartzite in the Strake well was not completely penetrated, so it is not known what rocks the quartzite overlies. If the quartzite in the Strake well is pre-Lamotte in age, there is a possibility that other sediments of Middle or Lower Cambrian age might lie beneath the quartzite and above the pre-Cambrian rocks. The uncertainty of the presence of sediments below the quartzite, the quartzite's hardness, and high drilling cost have deterred oil operators from trying to penetrate it completely even though it would be an ideal cap rock. The Killam well had not reached the quartzite when the hole was lost.

The fact that the Cretaceous and Tertiary reservoir beds contain large volumes of fresh water in the area is considered by some geologists to be adverse for commercial accumulations of oil or gas in them. At the base of the Cretaceous, where it rests upon the Paleozoic dolomites, there is in some wells a sand and chert conglomerate derived from the weathering of the Paleozoic rocks. This basal sand and conglomerate under proper conditions might be considered as an oil and gas trap.

The extreme hardness of the Paleozoic formations makes testing of these formations very expensive and unattractive when compared to the odds against obtaining commercial production of oil or gas from them. Testing of the Paleozoic formations requires use of expensive, heavy, drilling equipment.

Delineation of the Paleozoic structure by means of the seismograph is complicated by the truncated Paleozoic surface. Any of the Paleozoic formations at that surface would probably give reflections which would be very similar, and thus, only show the topographic surface rather than the true structural surface.

Table 1

Chemical Analyses of Waters from Alluvial Formation

Analyses by State Board of Health of Missouri
Results in parts per million

Well	1	2	3	4
Depth in feet	128	100	200?	155
Date analyzed	1–16–43	10–21–49	10–7–41	7–14–42
Analysis number	1238	2996	619	862
Turbidity	10.0	0.2	turbid	20.0
Odor (cold)	none	none	grassy	none
Color	none	none	none	none
Alkalinity ($CaCO_3$)				
Phenolphthalein	0	0	0	0
Total	176.0	256.0	44.0	156.0
Bicarbonates (HCO_3)	214.9	310.6	53.3	190.2
Carbonates (CO_3)	0	0	0	0
Insoluble	14.8	nd	20.0	18.0
Iron and Aluminum Oxides ($Al_2O_3Fe_2O_3$)	2.0	nd	2.4	1.6
Silica (SiO_2)	nd	24.0	nd	nd
Iron (Fe) total	1.2	1.6	6.5	1.6
Aluminum (Al)	0	0.1—	0	0
Sodium and Potassium (Na)	6.6	12.1	8.7	11.5
Calcium (Ca)	53.5	73.8	12.0	53.5
Magnesium (Mg)	11.6	18.6	5.9	10.7
Sulfates (SO_4)	11.9	18.3	17.3	26.1
Chlorides (Cl)	7.1	18.5	10.7	16.9
Fluorides (Fl)	nd	nd	nd	nd
Residue on evaporation				
Total	235.0	541.0	159.4	318.0
Dissolved	235.0	541.0	126.0	318.0
Suspended	nd	nd	33.4	nd
Loss on ignition	54.0	263.0	38.0	120.0
Total hardness ($CaCO_3$)	182.0	251.0	54.0	178.0
Carbonate hardness ($CaCO_3$)	176.0	256.0	44.0	156.0
Non-Carbonate hardness ($CaCO_3$)	6.0	5.0	10.0	22.0
Nitrate Nitrogen (N)	0.19	0 32	0.03	0.15

1. City of Senath, No. 1 well, NW SW SW sec. 1, T. 17 N., R. 8 E., Dunklin County.
2. City of Portageville, No. 1 well, SE NW sec. 30, T. 21 N., R. 13 E., New Madrid County.
3. City of Lilbourn, well, center sec. 25, T. 23 N., R. 13 E., New Madrid County.
4. City of Kennett, No. 2 well, NE sec. 2, T. 18 N., R. 9 E., Dunklin County.

Table 2

Chemical Analyses of Waters from Wilcox Formation

Analyses by State Board of Health of Missouri
Results in parts per million

	1	2	3	4	5	6
Well						
Depth in feet	405	550	400	505	1380	1748
Date analyzed	8–29–41	8–9–41	7–10–42	11–4–41	6–9–43	8–28–41
Analysis number	557	553	808	652	1133	569
Turbidity	10.0	nd	5.0	15.0	25.0	40.0
Odor (cold)	none	nd	nd	none	none	none
Color	none	nd	nd	none	none	none
Alkalinity ($CaCo_3$)						
Phenolphthalein	2.5	0	nd	0	0	0
Total	122.0	255.0	115.0	132.0	73.0	89.0
Bicarbonates (HCO_3)	143.2	310.7	139.7	161.4	89.2	108.1
Carbonates	3.0	0	0	0	nd	0
Insoluble	9.6	22.4	14.0	10.8	7.2	6.8
Iron and Aluminum Oxides ($Al_2O_3Fe_2O_3$)	1.6	2.0	1.6	1.2	2.0	1.6
Silica (SiO_2)	nd	nd	nd	nd	nd	nd
Iron (Fe) Total	1.6	8.8	0.8	2.0	2.0	2.0
Aluminum (Al)	nd	nd	nd	nd	nd	nd
Sodium and Potassium (Na)	11.2	15.7	4.9	2.8	31.5	42.8
Calcium (Ca)	31.9	75.1	34.2	40.4	5.7	5.0
Magnesium (Mg)	7.9	19.0	7.2	8.4	2.5	1.6
Sulfates (SO_4)	3.5	19.8	2.5	1.9	12.9	14.0
Chlorides (Cl)	10.7	17.8	9.4	5.1	6.2	9.1
Fluorides (Fl)	nd	nd	nd	nd	0.3	nd
Residue on evaporation						
Total	200.0	401.4	179.0	190.8	125.0	168.0
Dissolved	200.0	381.0	179.0	176.0	125.0	168.0
Suspended	nd	20.4	nd	14.8	nd	nd
Loss on Ignition	94.0	117.0	55.0	69.0	42.0	33.0
Total hardness ($CaCO_3$)	112.0	266.0	116.0	135.0	24.0	20.0
Carbonate hardness ($CaCO_3$)	112.0	255.0	115.0	132.0	24.0	20.0
Non-Carbonate hardness ($CaCO_3$)	0	11.0	1.0	3.0	0	0
Nitrate Nitrogen (N)	0.10	0.25	0.06	0.37	0.23	0.04

1. City of Sikeston, No. 3 well, SW SW SE sec. 19, T. 26 N., R. 14 E., Scott County.
2. City of Portageville, No. 2 well, SW SE SW sec. 30, T. 21 N., R. 13 E., New Madrid County.
3. City of Charleston, No. 2 well, SW NE NE sec. 5, T. 26 N., R. 16 E., Mississippi County.
4. City of East Prairie, No. 1 well, SW sec. 25, T. 25 N., R. 15 E., Mississippi County.
5. City of Caruthersville, No. 3 well, C. SW sec. 16, T. 18 N., R. 13 E., Pemiscot County.
6. City of Deering, No. 2 well, SE SW SE sec. 17, T. 18 N., R. 11 E., Pemiscot County.

Table 3

Chemical Analyses of Waters from McNairy (Ripley) Formations

Analyses by State Board of Health of Missouri
Results in parts per million

Well	1	2	3	4	5	6	7
Depth in feet	860	1600	1717	960	690	286	1335
Date analyzed	12–16–42	4–13–42	1–30–46	4–7–44	4–26–45	2–5–45	1–5–49
Analysis number	974	751	1875	1308	1599	1465	2793
Turbidity	0.1	0.1	0.6	0.2	0.2	10.0	0.4
Odor (cold)	none	none	none	none	none	none	none
Color	none	none	none	none	none	none	none
Alkalinity ($CaCo_3$)							
Phenolphthalein	0	2.4	0	0	0	0	0
Total	226.0	455.0	350.0	237.0	155.0	117.0	122.0
Bicarbonates (HCO_3)	274.9	548.3	426.3	288.4	188.4	142.6	148.1
Carbonates (CO_3)	0	2.9	0	0	0	0	0
Insoluble	9.6	10.4	9.2	9.2	11.6	10.4	0
Iron and Aluminum Oxides ($Al_2O_3Fe_2O_3$)	1.6	1.2	nd	1.2	nd	2.0	0
Iron (Fe) total	0.14	0.04	0.2	0.1	0.2	1.5	0.8
Aluminum (Al)	nd	nd	0.1—	nd	0.1	nd	0.1—
Sodium and Potassium (Na)	142.1	213.4	182.5	136.6	239.7	15.1	241.7
Calcium (Ca)	11.4	3.6	1.9	6.4	46.8	27.1	76.1
Magnesium (Mg)	3.5	0.9	0.9	2.3	12.4	11.0	20.4
Sulfates (SO_4)	11.9	1.0	6.4	13.6	34.6	13.2	40.1
Chlorides (Cl)	86.6	10.3	42.2	57.1	362.0	8.9	468.0
Fluorides (Fl)	0.2	nd	0.3	nd	nd	nd	nd
Residue on evaporation							
Total	426.0	558.0	492.0	391.0	832.0	175.0	980.0
Dissolved	426.0	558.0	492.0	391.0	832.0	175.0	980.0
Loss on ignition	70.0	149.0	176.0	69.0	900.0	60.0	145.0
Total hardness ($CaCO_3$)	43.0	13.0	9.0	15.0	168.0	113.0	274.0
Carbonate hardness ($CaCO_3$)	43.0	13.0	9.0	15.0	155.0	113.0	122.0
Non-Carbonate hardness ($CaCO_3$)	0	0	0	0	13.0	0	152.0
Nitrate Nitrogen (N)	0.07	0.68	0.09	0.30	0.20	0.13	0.08

1. U. S. Army, Basic Flying School, No. 2 well, SW SW SE sec. 28, T. 23 N., R. 10 E., Dunklin County.
2. City of Kennett, No. 3 well, SE NE NE sec. 2, T. 18 N., R. 9 E., Dunklin County.
3. City of Senath, No. 3 well, SE SW SE sec. 2, T. 17 N., R. 8 E., Dunklin County.
4. Campbell Lumber Company, No. 1 well, SW SW SE sec. 3, T. 21 N., R. 9 E., Dunklin County.
5. City of Bernie, No. 1 well, NW SE NW sec. 3, T. 23 N., R. 10 E., Stoddard County.
6. City of Bloomfield, No. 2 well, NE SE NE sec. 23, T. 26 N., R. 10 E., Stoddard County.
7. City of Lilbourn, No. 1 well, Near C. sec. 35, T. 23 N., R. 13 E., New Madrid County.

Table 4

Chemical Analyses of Waters from Paleozoic Formations

*Analyses by State Board of Health of Missouri. **Analyses by Missouri Geological Survey and Water Resources.
Results in parts per million.

Well	1	2	3	4	5	6	7	8	9	10	11
Formation	Gasconade	Eminence	St. Peter	Powell?	St. Peter	St. Peter	Eminence	Jeff. City	Gasconade	Jeff. City	Potosi
Depth in feet	635	927	925	780	922	433	2075	1500	508	740	2910
Date analyzed	10-11-45	2-18-29	10-28-32	8-30-36	5-7-45	3-27-45	3-27-45	11-27-34	6-3-43	10-28-32	10-28-32
Analyst	*	**	**	**	*	*	*	**	*	**	**
Analysis number	1730	1300	724	1934	1537	1631	1631	1297	1067	727	725
Turbidity	0.1	clear	sl. turbid	sl. turbid	0.1	1.0	0.1	clear	0.1	sl. turbid	turbid
Odor (cold)	none	none	none	none	none	none	none	none	none	none	none
Color	none	none	none	none	none	none	none	none	none	none	none
Alkalinity ($CaCO_3$)											
Phenolphthalein	0	nd	nd	nd	0	0	0	nd	0	nd	nd
Total	259.0	234.8	216.0	136.2	286.0	298.0	355.0	284.9	283.0	197.4	244.0
Bicarbonates (HCO_3)	315.6	258.0	263.4	166.1	348.5	362.7	433.3	347.4	344.8	240.7	297.6
Carbonates (CO_3)	0	13.8	1.4	0	0	0	0	0	0	9.8	4.2
Insoluble	6.8	nd	nd	nd	14.0	16.8	10.8	nd	14.8	nd	nd
Silica (SiO_2)	nd	9.6	9.2	10.0	nd	nd	nd	17.6	nd	2.8	9.6
Iron and Aluminum Oxides ($Al_2O_3Fe_2O_3$)	nd	nd	nd	nd	nd	nd	nd	nd	1.2	nd	nd
Iron (Fe)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total	0.2	0.58	0.30	0.14	0.2	0.06	0.08	0.05	0.04	0.20	0.20
Precipitated	nd	nd	2.97	1.50	nd	nd	nd	nd	nd	3.96	7.92
Aluminum	0.1–	1.47	nd	nd	0.1–	0.1–	0.1	nd	nd	nd	nd
Sodium and Potassium (Na)	2.2	11.3	124.0	615.7	13.5	10.9	40.1	18.4	11.1	22.3	98.7
Calcium (Ca)	55.4	56.6	76.1	188.1	76.4	73.5	98.4	63.5	66.3	14.4	77.5
Magnesium (Mg)	30.6	20.5	31.4	51.5	21.9	26.9	49.5	30.7	35.4	39.4	26.7
Sulfates (SO_4)	1.2	4.9	111.3	47.9	5.8	3.1	8.4	10.9	12.6	19.1	8.2
Chlorides (Cl)	4.7	14.3	162.9	1339.4	13.4	6.4	111.2	25.6	18.7	6.3	162.9
Residue on evaporation											
Total	543.0	nd	751.8	2695.4	400.0	397.0	668.0	388.0	469.0	295.4	653.4
Dissolved	543.0	262.0	748.0	2679.0	400.0	397.0	668.0	388.0	469.0	291.0	639.0
Suspended	nd	trace	3.8	16.4	nd	nd	nd	nd	nd	4.4	14.4
Loss on ignition	278.0	nd	158.0	493.0	168.0	172.0	273.0	106.0	204.0	153.0	228.0
Total hardness ($CaCO_3$)	264.0	225.8	319.0	681.4	281.0	294.0	449.0	284.0	311.0	197.5	303.2
Carbonate hardness ($CaCO_3$)	259.0	nd	216.0	136.2	281.0	294.0	355.0	284.6	283.0	197.4	244.0
Non-Carbonate hardness ($CaCO_3$)	5.0	nd	129.6	82.9	0	0	94.0	151.0	28.0	40.9	168.1
Nitrate Nitrogen (N)	0.13	1.89	1.37	0	0.19	0.50	0.15	2.80	1.5	5.53	2.01

1. City of Lutesville, No. 1 well, C.N½ SE sec. 6, T. 30 N., R. 10 E., Bollinger County.
2. Missouri Arkansas Power Company well, SE sec. 3, T. 24 N., R. 6 E., Butler County.
3. Marquette Cement Company, No. 1 well, NW SE NE sec. 18, T. 30 N., R. 14 E., Cape Girardeau County.
4. Himmelberger-Harrison Manf. Co., No. 1 well, SW SW SE sec. 31, T. 26 N., R. 13 E., New Madrid County.
5. City of Illmo, No. 1 well, SE SE NW sec. 3, T. 29 N., R. 14 E., Scott County.
6. City of Fornfelt, No. 1 well, NE NW NE sec. 5, T. 29 N., R. 14 E., Scott County.
7. City of Chaffee, No. 2 well, NE SW NE sec. 18, T. 29 N., R. 13 E., Scott County.
8. County Court, No. 1 Jail well, NE NW NW sec. 13, T. 28 N., R. 13 E., Scott County.
9. Missouri Power and Development Co., No. 1 well, (Puxico), SW SW SE sec. 26, T. 27 N., R. 8 E., Stoddard County.
10. Kentucky Oil and Gas Co., No. 6 well, NE NE NE sec. 31, T. 28 N., R. 11 E., Stoddard County.
11. Semo Development Co., No. 1 Himmelberger well, NE NE SW sec. 28, T. 27 N., R. 12 E., Stoddard County.

Table 5

Chemical Analyses of Waters from Paleozoic Formations Showing Change in Quality of Water with Depth

Analyses by Missouri Geological Survey and Water Resources
Results in parts per million
*Benedum-Trees Oil Company, C. W. Mack No. 1 well.
NW SW SW sec. 3, T. 15 N., R. 12 E., Mississippi County, Arkansas.

Depth of sample in feet	2960	3362	3805	4254	4412	4533
Formation	Jeff. City	Roubidoux	Gasconade	Gasconade	Eminence	Eminence
Turbidity	turbid	turbid	turbid	turbid	turbid	turbid
Color	none	none	none	none	none	none
Odor	Kerosene	none	none	none	none	none
Total suspended solids	nd	nd	nd	nd	nd	nd
Total dissolved solids	13302.0	19885.0	21970.0	21613.0	22375.0	22035.0
Loss on ignition	604.0	2824.0	2000.0	2550.0	2672.0	1551.0
Chloride radicle (Cl)	6840.0	9400.0	10045.4	10303.5	11071.6	11017.0
Nitrate radicle (NO_3)	0	0	0	none	0	0
Sulfate (SO_4)	934.5	1356.9	2902.3	1519.7	1629.7	1709.0
Bicarbonate radicle (HCO_3)	39.2	43.6	69.7	55.2	95.7	144.3
Carbonate radicle (CO_3)	41.4	0	0	0	0	0
Sodium (Na) Potassium (K) as NA	4020.5	5171.2	5950.2	5971.8	6052.5	5948.2
Magnesium (Mg)	1.2	279.3	316.1	306.0	618.6	402.6
Iron (Fe)	0.18	0.15	0.10	0.10	0.80	0.42
Manganese (Mn)	nd	nd	nd	nd	nd	nd
Silica (SiO_2)	6.0	4.0	2.4	3.6	12.8	20.0
Calcium (Ca)	820.6	875.6	1351.3	880.4	1009.1	1398.5
Total hardness	2056.4	3334.1	4674.3	3455.6	5059.0	5146.9
Carbonate hardness	101.2	35.8	57.2	45.3	78.5	118.3
Alkalinity	101.2	35.8	57.2	45.3	78.5	118.3
Precipitated Iron	nd	nd	nd	nd	nd	nd
Temporary hardness	38.1	13.2	33.4	28.6	36.3	73.8
Al_2O_3	2.00	1.79	168.66	.26	.86	1.40

Table 6

Water Levels and Yields of McNairy (Ripley) Wells

Well	Depth, feet	Flow at ground level, g.p.m.	Height above ground to which water level rose, feet	Altitude to which water level rose, feet	Yield when pumped, g.p.m.	Water level below ground surface when pumped, feet
Bernie	890	125	nd	nd	500	100
Bloomfield	286	no flow	0	333	150	150
Campbell	960	16	7	311	150	80
Dexter	345	35	5.5	325.5	408	67.4
Hayti	2153	125?	nd	nd	nd	nd
Hornersville	1846	150?	81	327	nd	nd
Kennett	1600	115	55	350	460	165
Lilbourn	1335	nd	45	325?	100	100
Malden Airfield	890	250	18	310	525	60
Senath	1717	100	73	332	300	9
Gideon No. 4	1330	176	nd	270?	381	nd
Gideon No. 5	1308	720	39	304	nd	nd

Table 7

Water Levels and Yields of Wilcox Group Wells

Well	Depth, feet	Depth below ground of water level, feet	Altitude of water level, feet	Yield when pumped, g.p.m.	Water level below ground surface when pumped, feet
Caruthersville No. 2	812	21	249	400	63
East Prairie	505	7.5	308	168	159.3
Parma	475	11	270	200	37
Portageville	550	19	249	100	69
Sikeston	405	27	300	918	62
Steele	321	8	252	350	nd

REFERENCES CITED

Berry, E. W., 1911, The age of the type exposures of the Lafayette formation: Jour. Geology, vol. 19, pp. 249-256.

———, 1916, The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. paper 91, pp. 36-38.

———, 1922, Northernmost extension of marine Eocene beds in Mississippi embayment: Pan-Am. Geologist, vol. 37, no. 1, pp. 75-76.

Bridge, J., 1930, Geology of the Eminence and Cardareva quadrangles: Missouri Bur. Geology and Mines, 2d ser., vol. 24.

Buehler, H. A., 1939, Geological map of Missouri: Missouri Geol. Survey and Water Res.

Call, R. E., 1891, The geology of Crowley's Ridge: Arkansas Geol. Survey Ann. Rept. 1889, vol. 2.

Crane, G. W., 1912, The iron ores of Missouri: Missouri Bur. Geol. and Mines, 2d ser., vol. 10.

Crider, A. F., and Johnson, L. C., 1906, Summary of the underground water resources of Mississippi: U. S. Geol. Survey Water-Supply Paper 159.

Dake, C. L., 1918, The sand and gravel resources of Missouri: Missouri Bur. Geol. and Mines, 2d ser., vol. 15, pp. 189-203.

———, 1930, The geology of Potosi and Edgehill quadrangles: Missouri Bur. Geol. and Mines, 2d ser., vol. 23.

Farrar, W., Grenfell, D. S., and Allen, V. T., 1935, The geology and bleaching clays of southeast Missouri: Missouri Geol. Survey and Water Res., 58th Bienn. Rept. 1933-34, App. 1.

———, and McManamy, L., 1937, The geology of Stoddard County, Missouri: Missouri Geol. Survey and Water Res., 59th Bienn. Rept. 1935-36, App. 6.

Fisk, H. N., 1944, Geological investigation of the alluvial valley of the lower Mississippi River: Mississippi River Commission, Vicksburg, Mississippi.

Freeman, L. B., 1945, (Paleozoic geology), Geology and mineral resources of the Jackson Purchase region, Kentucky: Kentucky Dept. Mines and Minerals, Geol. Div. Bull., ser. 8, no. 8, pp. 12-43.

———, 1949, Regional aspects of Cambrian and Ordovician subsurface stratigraphy in Kentucky: Am. Assoc. Petroleum Geologists Bull., vol. 33, pp. 1655-1682.

———, 1951, Regional aspects of Silurian and Devonian subsurface stratigraphy in Kentucky: Am. Assoc. Petroleum Geologists Bull., vol. 35, pp. 1-62.

Fuller, M. L., 1912, The New Madrid earthquake: U. S. Geol. Survey Bull. 494.

Glenn, L. C., 1905, Underground waters of Tennessee and Kentucky west of Tennessee River and of an adjacent area in Illinois: U. S. Geol. Survey Water-Supply Paper 164.

Grohskopf, J. G., and McCracken, E., 1949, Insoluble residues of some Paleozoic formations of Missouri, their preparation, characteristics and application: Missouri Geol. Survey and Water Res., Rept. of Inv., no. 10.

Harris, G. D., 1894, On the geological position of the Eocene deposits of Maryland and Virginia: Am. Jour. Sci., 3d ser., vol. 47, pp. 303-304.

———, 1896, The Midway stage: Bull. Am. Paleontology no. 4, pp. 10-38.

Heller, R. L., 1943, Geology of the Marble Hill area, Bollinger County, Missouri: Unpublished thesis, University of Missouri.

Hilgard, E. W., 1860, Report on the geology and agriculture of the state of Mississippi, vol. XXIV, Jackson, pp. 110-111.

———, 1891, Orange sand, Lagrange, and Appomattox: Am. Geologist, vol. 8, pp. 129-131.

———, 1892, The age and origin of the Lafayette formation: Am. Jour. Sci., 3d ser., vol. 43, pp. 389-402.

Jillson, W. R., 1929, Geologic map of Kentucky: Kentucky Geol. Survey, ser. 6.

Keyes, C. R., 1894, Paleontology of Missouri, part I: Missouri Geol. Survey, vol. 4, p. 87.

———, 1915, Foundation of exact geologic correlation: Iowa Acad. Sci. Proc., vol. 22, p. 252.

Kidwell, A. L., 1947, Post-Devonian igneous activity in southeastern Missouri: Missouri Geol. Survey and Water Res., Rept. of Inv., no. 4.

King, H., 1951, Some remarks on the geology of the State of Missouri: Am. Assoc. Adv. Sci. Proc., vol. 5, pp. 183, 198.

Lamar, J. E., 1928, Preliminary report on the fuller's earth deposits of Pulaski County: Illinois Geol. Survey Rept. Inv. 15.

———, and Sutton, A. H., 1930, Cretaceous and Tertiary of Kentucky, Illinois, and Missouri: Am. Assoc. Petroleum Geologists Bull., vol. 14, no. 7, pp. 845-866.

Langdon, D. W., 1891, Variations in the Cretaceous and Tertiary strata of Alabama: Geol. Soc. America Bull., vol. 2, pp. 589-605.

Leighton, M. M., and Willman, H. B., 1950, Loess formations of the Mississippi Valley: Illinois Geol. Survey Rept. Inv. 149, p. 617.

Lowe, E. N., 1914, Preliminary report on iron ores of Mississippi: Mississippi Geol. Survey Bull. 10.

———, 1933, Coastal Plain stratigraphy of Mississippi, part first, the Midway and Wilcox groups: Mississippi State Geol. Survey Bull. 25.

McGee, W. J., 1891, The Lafayette formation: U. S. Geol. Survey 12th Ann. Rept., pt. 1, pp. 347-521.

McQueen, H. S., 1940, Magnetic map of southeast Missouri embayment area: Missouri Geol. Survey and Water Res.

———, and others, 1939, Notes on Paleozoic, Mesozoic, and Cenozoic stratigraphy of southeastern Missouri: Kansas Geol. Soc. Guidebook, 15th Ann. Field Conf., pp. 59-76.

Magill, Prof., 1950, Cape Girardeau Southeast Missourian, December 6, 1950.

Marbut, C. F., 1902, The evolution of the northern part of the lowlands of southeastern Missouri: Missouri Univ. Studies, vol. 1, no. 3.

Matthes, F. E., 1933, Cretaceous sediments in Crowley's Ridge, southeastern Missouri: Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 8, pp. 1003-1009.

Owen, D. D., 1858, First report of a geological reconnaissance of the northern counties of Arkansas during the years 1857 and 1858, Little Rock, p. 20.

Richards, H. G., 1939, Marine Pleistocene of the Gulf Coastal Plain; Alabama, Mississippi, and Louisiana: Geol. Soc. America Bull. vol. 50, no. 2, pp. 297-316.

Safford, J. M., 1856, A geological reconnaissance of the State of Tennessee; being the author's first biennial report, Nashville, pp. 148-162.

———, 1864, On the Cretaceous and superior formations of west Tennessee: Am. Jour. Sci., 2d ser., vol. 37, pp. 361-368.

———, 1869, Geology of Tennessee, Nashville.

Salisbury, R. D., 1891, On the relationship of the Pleistocene to the pre-Pleistocene formations of Crowley's Ridge and adjacent areas south of the limit of glaciation: Arkansas Geol. Survey Ann. Rept. 1889, vol. 2, pp. 234-235.

Shepard, E. M., 1907, Underground waters of Missouri, their geology and utilization: U. S. Geol. Survey Water-Supply Paper 195, pp. 24-29.

Smith, E. A., 1886, Summary of the lithological and stratigraphic features and subdivisions of the Tertiary of Alabama: Alabama Geol. Survey Bull. 1, pp. 7-14.

Smith, H. M., 1951, Written communication to Edward L. Clark of the Missouri Geol. Survey and Water Res., Jan. 2.

Stephenson, L. W., 1914, Cretaceous deposits of the eastern Gulf region and species of *Exogyra* from the eastern Gulf region and the Carolinas: U. S. Geol. Survey Prof. Paper 81.

———, 1938, Stratigraphy of Upper Cretaceous series in Mississippi and Alabama: Am. Assoc. Petroleum Geologists Bull., vol. 22, no. 12, pp. 1639-1657.

———, 1942, Written communication to H. S. McQueen of the Missouri Geol. Survey and Water Res., Jan. 16.

———, and Crider, A. F., 1916, Geology and ground waters of northeastern Arkansas: U. S. Geol. Survey Water-Supply Paper 399.

———, and Monroe, W. H., 1937, Prairie Bluff chalk and Owl Creek formation of eastern Gulf region: Am. Assoc. Petroleum Geologists Bull., vol. 21, no. 6, pp. 806-809.

Stewart, D. R., 1942, The Mesozoic and Cenozoic geology of southeastern Missouri: Unpublished manuscript in files of Missouri Geol. Survey and Water Res.

———, 1948, Personal communication.

———, and McManamy, L., 1944, Early Quaternary or late Tertiary folding in the vicinity of Commerce, Scott County, southeastern Missouri. (manuscript report in files of Missouri Acad. of Sci.).

———, McManamy, L., and McQueen, H. S., 1943, Occurrence of bauxitic clay in Stoddard County, Missouri: Missouri Geol. Survey and Water Res., 62d Bienn. Rept. 1941-42, App. 3.

Wade, B., 1926, The fauna of the Ripley formation on Coon Creek, Tennessee: U. S. Geol. Survey Prof. Paper 137.

Weller, S. and St. Clair, S., 1928, Geology of Ste. Genevieve County, Missouri: Missouri Bur. Geol. and Mines, 2d ser., vol. 22.

Wells, F. G., 1933, Ground water resources of western Tennessee: U. S. Geol. Survey Water-Supply Paper 656.

Wheeler, H. A., 1896, Clay deposits: Missouri Geol. Survey, vol. 11, pp. 348-351.

Wilmarth, M. G., 1938, Lexicon of Geologic Names of the United States (including Alaska): U. S. Geol. Survey Bull. 896, part 2 M-Z, pp. 2333-2334.

Wilson, M. E., 1922, The occurrence of oil and gas in Missouri: Missouri Bur. Geol. and Mines, 2d ser., vol. 16, pp. 263-264.

Woyski, M. Skillman, 1947, Unpublished memorandum: Missouri Geol. Survey and Water Res.

WELL RECORDS

The more important wells of record are shown on the map, plate I. The wells, beginning with number 1 in the northeast portion of each county, are numbered in consecutive order to the west and south, thus, the highest numbered well in any county appears in the southeast portion of that county. With this method of numbering, the same well number will appear in several counties. The logs of wells published in this report are identified by county name and are numbered to correspond to the map number for each well. The following tabulation indexes the map number of each well log in each county published in this report. The heading on some of the logs is marked by an asterisk which indicates that those holes were drilled for mineral, oil, or gas. Some of the drillers' logs published may have been published previously elsewhere, but because they were in the Missouri Geological Survey files without their source being indicated it has been impractical to find and accredit the origin of such logs. It was not desirable for the Missouri Geological Survey to give all the details of wells drilled in adjoining states. For some of the states the depth to certain subsurface formations are given as summary logs. The numbering system used for Missouri wells does not apply for wells in adjoining states. Arkansas wells are numbered from west to east; Tennessee, Illinois, and Kentucky wells from south to north.

The drilling time records published with this report have been summarized because of space limitations, but copies of the detailed records may be obtained upon request from the office of the Missouri Geological Survey and Water Resources, P. O. Box 250, Rolla, Missouri.

WELL LOG INDEX

Sample log of the City of Lutesville, No. 1 well. Location: C. N½ SE sec. 6, T. 30 N., R. 10 E., Bollinger County, Missouri. Elevation: 415 feet. Completed July 5, 1941 by L. Goggins of Elvins, Missouri. Well No. 1 on map, Pl. 1. Mo. G. S. No. 6957.

	Thickness, Feet	*Depth, Feet*
Canadian system:		
Cotter? and Jefferson City formations:		
Dolomite, cherty, chert is white to tan finely porous and dolomoldic. Red mud 145-170 feet. Some green shale at 280 feet	280	280
Roubidoux formation:		
Dolomite, slightly cherty and sandy, chert with sand grains, solid chert 365-375 feet	205	485
Ozarkian system:		
Upper Gasconade formation:		
Dolomite, medium crystalline, a few sand grains, very little chert which is gray quartzose	135	620
Lower Gasconade formation:		
Dolomite, crystalline, with smooth white chert	15	635

NOTE: The well was cased with 256 feet of 8 ⅝-inch casing. Before casing, the well flowed 10 gallons per minute, after casing 20 gallons per minute. On a 24-hour pump test the yield was 60 gallons per minute with 77 feet of drawdown.

***Sample log of the P. Deimund, Cooper No. 1 well. Location: SE cor. sec. 14, T. 29 N., R. 9 E., Bollinger County, Missouri. Elevation: 370 feet. Commenced December 1938 by P. Deimund of Cape Girardeau, Missouri. Well No. 2 on map, Pl. 1. Mo. G. S. No. 7682.**

	Thickness, Feet	*Depth, Feet*
No samples	50	50
Canadian system:		
Cotter formation:		
Dolomite, cherty, chert is smooth and tan colored	55	105
Swan Creek? member:		
Dolomite, with some sandstone	25	130
Jefferson City formation:		
Dolomite, slightly cherty, chert is white, finely porous to dolomoldic, smooth tan, and some white oolitic	270	400
Roubidoux formation:		
Dolomite with sandy chert and thin sandstones	200	600
Ozarkian system:		
Upper Gasconade formation:		
Dolomite, non-cherty, some gray quartzose, silica, and a few grains of sand	150	750
Lower Gasconade-Van Buren formations:		
Dolomite, gray, crystalline, with blue, smooth, and some white dolomoldic chert	340	1090
Gunter member:		
Dolomite, slightly cherty and some sand. Chert is blue, smooth, and white, finely dolomoldic	185	1275
Eminence formation:		
Dolomite, cherty, chert is gray and tan quartzose and smooth white to lacelike dolomoldic	205	1480
Potosi formation:		
Dolomite, with quartz druse and brown dolomoldic silica	365	1845

NOTE: The above well was an oil and gas test which is temporarily shut down. At 1235 feet 8-inch casing was set, with 5 ⅝-inch casing at 1540 feet. The strongest flow of water was at 850 feet.

Sample log of the Headquarter's Wappapello Dam, No. 1 well. Location: NE NE NE sec. 10 T. 26 N., R. 7 E., Butler County, Missouri. Elevation: 742 feet. Completed in summer of 1938 by Wallace Parkin & Sons of Poplar Bluff, Missouri. Well No. 1 on map, Pl. 1. Mo. G. S. No. 5013.

	Thickness, Feet	*Depth, Feet*
Canadian system:		
Roubidoux formation:		
Chert boulders, red clay and sandstone	105	105
Sandstone, with interbedded dolomite	145	250
Ozarkian system:		
Upper Gasconade formation:		
Dolomite, cream colored, coarsely crystalline, a few sand grains and white dolomoldic chert	145	395

NOTE: The well had 115 feet of 6-inch casing. The static water level was 95 feet and the yield was 10 gallons per minute.

Driller's log of the U. S. C.C.C. well F-18. Location: NE NE SW sec. 34, T. 26 N., R. 5 E., Butler County, Missouri. Elevation: 580 feet. Completed in June 1935 by E. A. Cullum of North Kansas City, Missouri. Well No. 2 on map, Pl. 1. Mo. G. S. No. 3369.

	Thickness, Feet	*Depth, Feet*
Soil, clay	5	5
Soft red flint clay, flint boulders	45	50
Soft red clay	20	70
Soft red clay	10	80
Soft red clay, lime boulders	24	104
Soft red lime flint, boulders clay	11	115
Tight red lime flint	4	119
Hard red lime flint	2	121
Soft red mud, boulders	2½	123½
Hard red lime flint	9½	133
Opening, water	2	135
Hard lime flint	13	148
Soft red open	3	151
Hard lime flint	27	178
Red mud open	3	181
Hard white lime flint	55	236
Soft white flint	1	237
Hard white lime flint	25	262
Hard white sand	3	265
Hard brown lime	5	270
Hard blue lime flint, blue flint	2	272
Lime flint, white flint	5	277
Lime flint, open red mud	2	279
Hard lime flint	41	320
Lime and flint, hard (Set 6¼" csg. @ 324)	4	324
Lime and flint, soft	4	328
Lime and flint, hard	52	380
Lime and flint, flint blue, hard	5	385
Lime and white flint	70	455
Lime and blue flint	8	463
Lime and white flint, hard	13	476
Water-lime, white	44	510
Lime, brown, hard	8	518
Flint, white and yellow	15	533
Flint, white and blue, hard	22	555
Lime, hard	25	580

Driller's log of the U. S. C.C.C. well F-18—Continued.

	Thickness, Feet	*Depth, Feet*
Lime	30	610
White sandy lime and water	21	631

NOTE: When completed, the well was cased with 128 feet of 8¼ and 320 feet of 6-inch casing. At 320 feet the static water level was 124 feet and upon completion 150 feet. The yield was 20 gallons per minute (pump capacity) with no drawdown. The following is a formational summary from an examination of the samples:

	Thickness, Feet	*Depth, Feet*
Canadian system:		
Roubidoux formation:	160	160
Ozarkian system:		
Upper Gasconade formation:	150	310
Lower Gasconade-Van Buren formations:	321	631

Sample log of the Missouri Arkansas Power Company well. Location: SE sec. 3, T. 24 N., R. 6 E., in Poplar Bluff, Butler County, Missouri. Elevation: 335 feet. Completed in January 1915 by Sewell Well Company, St. Louis, Missouri. Well No. 3 on map, Pl. 1. Mo. G. S. No. 1825.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand chiefly a few rounded, mostly small angular grains, white, some blue white chert and stream pebbles	17	20
Clay, dark, including impure quartz	15	35
No sample from 35 to 49 feet	14	49
Sand chiefly, white, small angular grains, some gray dolomite and brown chert pebbles	36	85
Ozarkian system:		
Upper Gasconade formation:		
Dolomite, finely crystalline, gray to dark brown, brown chert, and white sand grains	5	90
Dolomite, dark gray to dark brown, very finely crystalline, a few particles of brown chert and some white sand grains	5	95
Same as above, less sand	5	100
Dolomite, gray to brown, very finely crystalline	5	105
Dolomite, light brown to dark brown, finely crystalline	5	110
Dolomite, gray to blueish, crystalline, a few particles of chert and some white sand grains probably from above	5	115
Dolomite, brown to dark brown, fine, brown chert, white sand	5	120
Dolomite, brown, finely crystalline, some sand grains	5	125
Dolomite, brown to bluish-gray	5	130
Dolomite, blue crystalline, a few splinters of brown chert	5	135
Dolomite, gray, fine-grained	5	140
Dolomite, gray, light to dark, fine to crystalline	10	150
Same as above	5	155
Chert, yellow to blue, some dolomite	5	160
Gray to blue-gray dolomite and chert	5	165
Dolomite, gray, light to dark, fine-grained, a little chert	5	170
Dolomite, light to dark gray	5	175
Dolomite, gray, fine-grained	5	180
Dolomite, dark gray, finely crystalline, shows pitted surface under microscope	5	185
Dolomite, blue-gray	5	190

Sample log of the Missouri Arkansas Power Company well—Continued.

	Thickness, Feet	*Depth, Feet*
Lower Gasconade-Van Buren formation:		
Gray dolomite	5	195
Gray dolomite	5	200
Dolomite, gray, chert, dark blue	5	205
Dolomite, gray chert	5	210
Dolomite, light gray, chert light to dark, one piece shows faint oolitic structure	5	215
Dolomite, light gray, fine chert, bluish	5	220
Dolomite, light gray, finely crystalline, chert, bluish	5	225
Dolomite, bluish-gray, to light gray, finely crystalline	5	230
Dolomite, light gray, crystalline	5	235
Same as above	5	240
Dolomite, gray crystalline	5	245
Same as above, some chert	5	250
Same as above	5	255
Dolomite, brown	5	260
Dolomite, gray, chert, white to blue	5	265
Dolomite, gray crystalline, cherty light colored	5	270
Dolomite, blue-gray, finely crystalline	5	275
Same as above	5	280
Dolomite, cream colored, chert white to cream color	5	285
Same as above	5	290
Same as above	5	295
Same as above	5	300
Same as above	5	305
Dolomite, light gray to blue	5	310
Dolomite, light gray, chert light-blue	5	315
Same as above	15	330
Dolomite, gray, chert, yellow brown to blue	5	335
Same as above	5	340
Dolomite, white, chert, white to cream color	5	345
Same as above, cuttings stained brown	5	350
Dolomite, light gray, finely crystalline, chert light colored	5	355
Same as above	40	395
Dolomite, gray, darker than above	5	400
Dolomite, gray, finely crystalline	5	405
Same as above, chert light colored	5	410
Same as above, a little darker	5	415
Dolomite, light gray, hard	5	420
Dolomite, gray, finely crystalline	15	435
Dolomite, gray, chert, dark-blue	5	440
Same as above	10	450
Dolomite, brownish-gray	5	455
Same as above	15	470
Dolomite, bluish-gray, chert	5	475
Same as above	5	480
Dolomite, gray, crystalline	5	485
Same as above	10	495
Dolomite, light gray, harder than above crystalline	5	500
Dolomite, gray, finely crystalline, a little light colored chert	5	505
Dolomite, gray crystalline	5	510
Same as above	15	525
Dolomite, light gray and white chert	5	530
Dolomite, brownish-gray, white to blue chert	5	535
Same as above	5	540
Dolomite, soft, fine light gray, has appearance of "cotton rock"	5	545
"Cotton rock"	5	550
Dolomite, gray, finely crystalline, some "cotton rock"	5	555
Same as above	5	560
Same as above	5	565
Dolomite, gray and "cotton rock"	5	570
Dolomite, gray, finely crystalline	5	575

Sample log of the Missouri Arkansas Power Company well—Continued.

	Thickness, Feet	*Depth, Feet*
Same as above	20	595
Dolomite, gray, very finely crystalline	5	600
Dolomite, gray, chert blue	5	605
Dolomite, gray, chert, light blue, pyrite	5	610
Dolomite, very light gray, hard chert, a few particles of grain shale and pyrite	5	615
Same as above	5	620
Dolomite, gray	5	625
Gunter member:		
Dolomite, very light gray, white chert, looks like "cotton rock", few grains of sand	5	630
Dolomite, gray, pyrite, few grains of sand	5	635
Same as above	5	640
Dolomite, very light gray, some sand	5	645
Same as above, sand	10	655
Dolomite, gray, sand grains	5	660
Dolomite, gray, finely crystalline	5	665
Dolomite, light gray, few sand grains	5	670
Dolomite, light gray, blue chert	5	675
Dolomite, gray	5	680
Same as above	10	690
Dolomite, light gray, few grains of sand	5	695
Eminence formation:		
Dolomite, gray	5	700
Same as above	10	710
Dolomite, gray, some chert, oolitic	5	715
Dolomite, gray to brown-gray, chert oolitic	5	720
Dolomite, dark gray, free white siliceous oolites	5	725
Dolomite, light gray, free white siliceous oolites	5	730
Same as above	10	740
Dolomite, dark gray	5	745
Dolomite, gray crystalline	5	750
Same as above	5	755
Dolomite, gray, fine	5	760
Dolomite, blue-gray	5	765
Dolomite, gray, very crystalline, a large amount of rhombohedral crystals, looking like calcite but effervescing like dolomite	5	770
Dolomite, very crystalline, many rhombohedrons of "dolomite"	5	775
Dolomite, gray	5	780
Dolomite, gray	5	785
Same as above, less dolomitic than members above	40	825
Dolomite, gray	10	835
Same as above	25	860
Dolomite, gray, dolomite crystals	5	865
Same as above	5	870
Same as above	35	905
Dolomite, dark gray, free brown siliceous oolites	5	910
Same as above	17	927

NOTE: When the well was completed, it yielded 350 gallons of water per minute with 190 feet of drawdown from a static level of 10 feet.

***Driller's log of the Big Island Oil Company, Geo. Bates No. 1 well. Location: SE NE sec. 30, T. 24 N., R. 8 E., Butler County, Missouri. Elevation: 317 feet. Completed in July 1923 by H. K. Wimple and E. Lycette. Well No. 4 on map, Pl. 1. Mo. G. S. No. 3015.**

	Thickness, Feet	*Depth, Feet*
Sand and gravel	337	337
Lime, flinty, some pyrites of iron	2	339
Sandstone, coarse, considerable gas, small showing of oil	27	366
Rock, hard, drills 2 feet per day with rotary	34	400

Sample log of the Mississippi River Fuel Company, Boste Station No. 1 well. Location: SE SW SW sec. 9, T. 23 N., R. 5 E., near Taft, Butler County, Missouri. Elevation: 380 feet. Completed October 10, 1941 by Wallace Parkin and Sons of Poplar Bluff, Missouri. Well No. 5 on map, Pl. 1. Mo. G. S. Log No. 7288.

	Thickness, Feet	*Depth, Feet*
Ozarkian system:		
Upper Gasconade formation:		
Clay, red, chert boulders, and sandstone, probably Roubidoux in part	100	100
Dolomite, cream-gray, coarsely crystalline, with gray quartzose chert, few sand grains	60	160
Lower Gasconade formation:		
Dolomite, gray-blue, crystalline, with oolitic and dolomoldic blue to white chert	130	290

NOTE: The well had 86 feet of 6-inch casing and 160 feet of 5-inch liner. The static water level was 60 feet and the yield 46 gallons per minute. At 170 feet in depth only 7 gallons per minute was obtained.

***Driller's log of the Big Island Oil Company, Effie M. Ruth No. 1 well. Location: SW SW sec. 8, T. 23 N., R. 7 E., Butler County, Missouri. Elevation: 313 feet. Completed in 1922 by H. K. Wimple and E. Lycette. Well No. 6 on map, Pl. 1. Mo. G. S. No. 3012.**

	Thickness, Feet	*Depth, Feet*
Soil, black, soft	16	16
Quicksand, gray	240	256
Lime and flint, gray, hard	12	268
Sand rock, white, soft, thin streak of lignite 3 inches at 328	60	328
Mud, blue, soft	27	355
Gravel and shells	77	432
Boulders and large gravel	43	475
Mud, brown	28	503
Mud, blue	31	534
Quicksand, gray	163	697
Lime and sandstone streaked gray	24	721
Lime and coarse sandstone, white and gray	80	801
Mud, blue	166	967
Quicksand, gray	—	—

NOTE: Limestone from 256 to 268 was broken; gas at 268 to 270 blew water 25 feet up derrick. Well caved badly from 355 to 432; at 967 quicksand came 350 feet up in (well) 10-inch hole.

24-inch wooden conductor to 18 feet.
15½-inch drove to 110 feet.
12½-inch drove to 256 feet.
10-inch drove to 697 feet.

Driller's note: "Worst formation drillers had ever been in."

This was an unusual thickness of unconsolidated formations to be only 7 or 8 miles from the bluff line.

***Sample log of the Coastal Development Company, J. P. Pearson No. 1 well. Location: NW NE NW sec. 27, T. 22 N., R. 6 E., Butler County, Missouri. Elevation: 297 feet. Completed in December 1939 by Thad A. Bryant of Texarkana, Arkansas. Well No. 7 on map, Pl. 1. Mo. G. S. No. 6614.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, coarse-to-medium, some lignite	75	75
Gravel, chert, with igneous pebbles	60	135

Sample log of the Coastal Development Company, J. P. Pearson No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Sand, angular, lime shells, calcareous fossils, dark blue-gray clay	45	180
McNairy (Ripley) formation:		
Sand, coarse-grained, micaceous, with calcareous fossils	40	220
Sand, in aggregates cemented with calcite, calcareous fossil fragments	20	240
Clay, tan, mealy, calcareous fossils	60	300
Poor samples, recirculated sand, etc.	50	350
Sand, calcareous and glauconitic	40	390
Sand, white, coarse-grained, slightly calcareous and fossiliferous	87	477
Sand, white, coarse-grained, with white tripolitic chert (reworked)	33	510
Canadian system:		
Roubidoux formation:		
Dolomite, buff to cream crystalline, with smooth white sandy chert and sand	190	700
No samples	53	753

Sample log of the Midwest Dairy Company well. Location: Two blocks west of Mississippi River and due west of Frisco passenger station in Cape Girardeau. C. sec. 5 (projected), T. 30 N., R. 14 E., Cape Girardeau County, Missouri. Elevation: 353 feet. Completed June 1940 by Haverstick Well and Equipment Company of DeSoto, Missouri. Well No. 1 on map, Pl. 1. Mo. G. S. No. 6150.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, gray	23	23
Ordovician system:		
Kimmswick formation:		
Limestone, gray, crystalline	52	75
Decorah formation:		
Limestone, dark gray, dense. Insoluble residue about 10 percent and consists of green, fossiliferous shale	10	85
Plattin formation:		
Limestone, dark gray, dense to lithographic. Insoluble residue from 2 to 15 percent, dense gray chert, silicified fossil fragments, brown and gray silt or shale	325	410
Limestone, dark gray, dense. Insoluble residue 5 percent, silicified fossil fragment, gray shale	65	475
Limestone, dark gray, conglomeratic and oolitic, many ostracods	5	480
Limestone, oolitic and conglomeratic	25	505
Rock Levee formation:		
Limestone, dark gray, dense. Insoluble residue 5 to 10 percent, gray-green shale, tan shale	75	555
Limestone, dark gray, dense. Insoluble residue 5 to 15 percent, smooth gray dolomoldic chert with embedded silicified fossil spines	30	585
Limestone, dark gray, dense. Insoluble residue less than 5 percent, gray to tan shale	140	725

Sample log of the Midwest Dairy Company well—Continued.

	Thickness, Feet	*Depth, Feet*
Joachim formation:		
Limestone, dark gray, dense, dolomitic. Insoluble residue less than 5 percent, gray and tan shale, pyrite, some dead, gray-white chert and very fine sand from 775 to 800 feet. White chert at 775 feet	75	800
Dolomite, light cream to buff, finely crystalline. Insoluble residue 5 to 10 percent, very fine sand, brown shale, medium-grained sandstone from 875 to 880 feet	150	950
Dutchtown formation:		
Limestone, dark gray to black, dense, ostracods in upper 10 feet. Insoluble residue 10 to 30 percent, gray and brown shale	75	1025
Limestone, as above, ostracods. Insoluble residue 15 percent, brown shale, some sand	20	1045
Limestone, as above. Insoluble residue 20 to 50 percent, gray and tan shale, rounded and frosted sand	60	1105
St. Peter-Everton? formation:		
Sandstone, medium-to fine-grained	65	1170
Everton formation:		
Dolomite, cream, dense to finely crystalline. Insoluble residue 15 percent, sand and a little green shale	20	1190
Limestone, dark gray, dense, ostracods. Insoluble residue less than 5 percent, sand and green shale	10	1200

NOTE: The well was cased from the surface to 33 feet with 10-inch casing. The St. Peter-Everton? sandstone was shot with 75 quarts of nitroglycerin, after which a pump test gave a yield of 80 gallons per minute with 46 feet of drawdown. The water had a temperature of 61 degrees Fahrenheit.

Sample log of the Albert Wessell well. Location: NE NE NE sec. 17 (projected), T. 30 N., R. 13 E., Cape Girardeau County, Missouri. Elevation: 430 feet. Completed in March 1942 by Schneider and Gwin, Incorporated of Cape Girardeau, Missouri. Well No. 2 on map, Pl. 1. Mo. G. S. No. 7669.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Silt, yellow	25	25
Ordovician system:		
Joachim formation:		
Dolomite, buff, finely crystalline. Insoluble residue 10 percent, very fine sand, brown porous shale, white chert	50	75
Sandstone, sub-rounded, medium-grained	5	80
Dolomite, cream to buff, finely crystalline. Insoluble residue 5 to 20 percent, fine sand and brown porous shale	55	135
Dutchtown formation:		
Limestone, dark gray to black, dense. Insoluble residue 5 to 50 percent, gray-green shale, brown shale	50	185
Limestone, as above, ostracods. Insoluble residue 15 percent, tan finely porous shale	15	200
Limestone, as above, ostracods. Insoluble residue 15 to 40 percent, gray-green, finely porous shale	25	225
Limestone, as above, tiny ostracods. Insoluble residue 50 percent, gray-green and light gray shale with conodont casts, a little sand	35	260
St. Peter formation:		
Sandstone, white, medium-grained, rounded and frosted	15	275
Everton formation:		
Sandstone, white, medium-grained, some green shale	15	290
Sandstone, white, very fine-grained, dolomitic	10	300
Dolomite, cream, coarsely crystalline, sandy	10	310

Sample log of the Albert Wessell well—Continued.

	Thickness, Feet	*Depth, Feet*
Dolomite, dark gray, dense, sandy	20	330
Dolomite, as above, large ostracods	10	340

NOTE: This well was cased at 36 feet with 7-inch casing. The water level was 60 feet below the surface and the well yielded 9 gallons per minute. The thin section of St. Peter-Everton sandstone suggested that this well might have crossed a fault.

Sample log of the Marquette Cement Company, No. 1 well. Location: NW SE NE sec. 18 (projected), T. 30 N., R. 14 E., Cape Girardeau County, Missouri. Elevation: 345 feet. Completed in August 1934 by E. M. Gould of Cape Girardeau, Missouri. Well No. 3 on map, Pl. 1. Mo. G. S. No. 2950.

	Thickness, Feet	*Depth, Feet*
No samples (old well deepened)	123	123
Ordovician system:		
Plattin formation:		
Limestone, dark gray, dense. Insoluble residue less than 5 percent, tan porous shale	82	205
Limestone, as above, conglomeratic and oolitic	5	210
Limestone, dark gray, dense. Insoluble residue 5 to 15 percent, gray and tan porous shale	85	295
Limestone, dark gray, dense. Insoluble residue 5 to 15 percent, smooth gray-white, dolomoldic chert	20	315
Limestone, dark gray, dense. Insoluble residue 5 percent, gray and tan porous shale, ostracods 325 to 330 feet	180	495
Joachim formation:		
Dolomite, buff, finely crystalline. Insoluble residue 5 percent, brown shale, fine sand, some fluorite	180	675
Dutchtown formation:		
Limestone, dark gray to black, dense, ostracods 765 to 770 feet. Insoluble residue 10 to 40 percent, gray and brown shale	120	795
Limestone, dark gray to black, dense, ostracods 795 to 845 feet. Insoluble residue, 20 to 50 percent, gray and brown porous shale	65	860
St. Peter-Everton? formation:		
Sandstone, white, medium-grained	50	910
Everton formation:		
Limestone, gray, dense, sandy	5	915
Dolomite, buff, finely crystalline, sandy	10	925

NOTE: The well had 20-inch casing from the surface to 123 feet and 8-inch casing from the surface to 266 feet. The water level stood 85 feet from the surface, and when pumped at 12 gallons per minute the pumping level was 380 feet or 295 feet of drawdown. The St. Peter-Everton sandstone was shot with 550 pounds of 60 percent gelatin dynamite.

Sample log of the Beechwood Club, No. 1 well. Location: C. NE NE sec. 24 (projected), T. 30 N., R. 12 E., Cape Girardeau County, Missouri. Elevation: 360 feet. Completed in April 1940 by Clark & Johnson of Fredericktown, Missouri. Well No. 4 on map, Pl. 1. Mo. G. S. No. 2737

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay or silt, very fine, buff to yellow	70	70
Clay, gray, rather hard	30	100
Pebbles, chert, brown stained	5	105

Sample log of the Beechwood Club, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Ordovician system:		
Everton formation:		
Sand, medium-to-coarse, black sandy dolomite, some chert	25	130
Dolomite, dark gray to brown, finely crystalline, sandy	30	160
Sandstone, white, subangular, frosted grains	5	165
Dolomite, dark gray, finely crystalline	15	180
Sandstone, white, rounded and frosted grains	15	195
Dolomite, dark gray to brown, sandy, some sandy chert	95	290
Dolomite, as above, sandy. Insoluble residue 5 to 20 percent mostly sand, a few particles of brown shale	60	350
Dolomite, dark brown to gray, finely crystalline, very sandy. Insoluble residue about 50 percent, mostly sand, some gray shale	50	400
Dolomite, as above. Insoluble residue 5 to 50 percent, mostly sand, some sandy chert and brown shale	25	425
Canadian system:		
Smithville? formation:		
Dolomite, gray shale, brown shale, some sandy chert	100	525
Powell? formation:		
Dolomite, very sandy, translucent brown chert and green shale	84	609

Sample log of the Walter Adams, No. 1 well. Location: Filling station at northeast corner of the intersection of U. S. Highways No. 61 and No. 74. SW cor. sec. 13 (projected), T. 30 N., R. 13 E., Cape Girardeau County, Missouri. Elevation: 355 feet. Completed in May 1935 by E. M. Gould of Cape Girardeau, Missouri. Well No. 5 on map, Pl. 1. Mo. G. S. No. 3379.

	Thickness, Feet	*Depth, Feet*
Ordovician system:		
Rock Levee formation:		
Limestone, gray, dense. Insoluble residue 5 percent, tan quartzose chert, silicified brachiopod fragments, brown shale	10	10
Limestone, gray, dense. Insoluble residue 5 to 10 percent, gray and brown shale	85	95
Dolomite and dolomitic limestone, buff to brown finely crystalline. Insoluble residue 5 percent, brown shale and very fine sand	60	155
Joachim formation:		
Dolomite, buff, finely crystalline. Insoluble residue 5 percent smooth gray-white chert	5	160
Dolomite, as above. Residue 5 to 10 percent, fine sand, brown shale	95	255
Dolomite, as above. Insoluble residue, 20 percent, rounded and frosted sand	15	270
Dolomite, as above. Insoluble residue 5 to 30 percent, fine sand, brown and gray shale	60	330

NOTE: From the surface to 37 feet, 6-inch casing was set. The water level stood 35 feet beneath the surface and was at 135 feet when pumped at the rate of 8 gallons per minute.

The bluff back of this filling station was the locality at which in 1937 E. O. Ulrich and H. S. McQueen collected a fauna which Ulrich identified as correlative to that found in the Murfreesboro limestone of Tennessee and which he said was Stones River in age. The oolitic and conglomeratic zone, noted in the Midwest Dairy and Marquette Cement Company wells, would occur approximately 125 feet above the collar of this well. Dr. Josiah Bridge stated orally on September 5, 1941 to H. S. McQueen that fossils from this locality obtained by McQueen were also found in the Ridley formation. Among these fossils Bridge identified *Protorhyncha ridleyana.* He stated that the beds overlying the Ridley at Cape Girardeau were correlative with the Lebanon of Tennessee, and that the Stones River was really Black River.

***Driller's log of the Frisco Oil and Gas Company, Disa Green No. 1 well. Location: SW NE SE sec. 34, T. 23 N., R. 9 E., Dunklin County, Missouri. Elevation: 410 feet. Completed in August 1921 by J. A. Tweedle. Well No. 2 on map, Pl. 1.**

	Thickness, Feet	*Depth, Feet*
Surface soil	6	6
Hard sand	40	46
Soap stone	1	47
Sand	20	67
Soapstone	2	69
Sand	18	87
Clay	1	88
Sand	7	95
Quick sand	105	200
River gravel	3	203
Quick sand	75	278
Blue shale	32	310
Sand and water	10	320
Blue shale	40	360
Gumbo	6	366
Shale	35	401
Gumbo	8	409
Shale	120	529
Lime shell	1	530
Shale	38	568
Gumbo	3	571
Shale	100	671
Gumbo	17	688
Lime shell	2	690
Limestone	1½	691½
Sand, water, and gas sandstone	20	711½
Blue shale	9½	721
Fine sand and isinglass	9	730
Hard gumbo	10	740
Sand and clay	10	750
Brown marl	11	761
Gumbo and shale	19	780
Brown or oil bearing sand, water very dark	36	816
Sand rock	3	819
Hard sand and boulders	10	829
Gumbo, green gumbo		
Hard sand and boulders	53	882
Gumbo, and green gumbo	28	910
Soft black marl	15	925
Gumbo and small boulders	9	934
Gumbo shale green sand and boulders		
Iron pyrites 1 or 2 feet thick each	28	962
Fossilized lime rock	15	977
Sand	5	982
Shale	3	985
Hard lime	2	987

The following correlations are suggested by the log.

Tertiary system:		
Eocene series:		
Wilcox group:	320	320
Paleocene series:		
Midway group:		
Porters Creek formation:	368	688
Clayton formation:	4	692
Cretaceous system:		
Gulf series:		
Owl Creek and McNairy (Ripley) formations:	293	985
Canadian system:		
Roubidoux? formation:	2	987

NOTE: The base of the Wilcox group was chosen as the water bearing sand reported from 310 to 320 feet. Conceivably the base might be at 278 feet.

Sample log of the United States Army, Basic Flying School No. 2 well. Location: SW SW SE sec. 28, T. 23 N., R. 10 E., Dunklin County, Missouri. Elevation: 292 feet. Completed in September 1942 by C. M. Journey Company of Memphis, Tennessee. Well No. 3 on map, Pl. 1. Mo. G. S. No. 7937.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, red and white, arkosic	90	90
Gravel, pea size	25	115
Sand and gravel as above	43	158
Tertiary system:		
Eocene series:		
Wilcox group:		
Sand, white, polished grains, coarse, some gray clay	72	230
Sand, as above	70	300
Sand, as above with gray clay	60	360
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, dark gray, much recirculated sand	200	560
Clay, almost black	80	640
Clay, as above, recirculated sand	55	695
Clayton formation:		
Limestone, white, glauconitic, fossiliferous	10	705
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, sand and recirculated limestone	66	771
McNairy (Ripley) formation:		
Sand, white, medium-grained, sub-rounded	89	860

NOTE: Correlations based upon sample studies, drilling time, and driller's log.

The above well flowed an estimated 225 to 250 gallons per minute at ground level. The water rose to 18 feet above the ground surface. A pump test for 72 hours showed an average yield of 525 gallons per minute with pumping level of 60 feet or a drawdown of 78 feet. After the pump was shut off, the water rose to the surface in 2 minutes and 15 seconds. The water had a temperature of 72 degrees Fahrenheit.

Well No. 1 was drilled 1000 feet north and west of the above well and had the same elevation. This well was completed in November 1942 by the same contractor. It is well No. 1 on map, Pl. 1 Mo. G. S. No. 8024. The log of well No. 1 is similar to No. 2 except that the various contacts are all 10 feet higher in elevation. Well No. 1 was completed at 890 feet. The yield, drawdown, temperature, and flow from this well were similar to well No. 2. In well No. 1 there was set 765 feet of 10 inch pipe. Attached to the 10-inch pipe was 40 feet of 8-inch blank screen with 10 feet of lap into the 10-inch pipe and 50 feet of open screen number .012. The top of the open screen was at 795 feet and the bottom at 845 feet.

Sample log of the City of Malden, No. 5 well. Location: Sec. 10, T. 22 N., R. 10. E., Dunklin County, Missouri. Elevation: 294 feet. Completed in July 1945. Well No. 4 on map, Pl. 1. Mo. G. S. No. 8867.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
No samples	10	10
Sand, polished grains, some silt	40	50
Sand, as above, lignitic	5	55
Sand, as above	10	65

Sample log of the City of Malden, No. 5 well—Continued.

	Thickness, Feet	*Depth, Feet*
Sand, coarse, with gravel	30	95
Gravel, medium to coarse	10	105
Sand, coarse, some silt and gravel	20	125
Silt, gray	5	130

Driller's log of the Campbell Lumber Company, No. 1 well. Location: SW SW NE sec. 3, T. 21 N., R. 9 E., Dunklin County, Missouri. Elevation: 304 feet. Completed in September 1902 by Johnson and Fleming of Memphis, Tennessee. Well No. 5 on map, Pl. 1. Mo. G. S. No. 128.

	Thickness, Feet	*Depth, Feet*
Yellow clay, a little darker than that on Crowleys Ridge	112	112
Orange sand and gravel, the sand has many white, loamy clay nodules mixed in it	43	155
Very hard black and brown clay or marl, with numerous very hard strata from 1 to 23 inches thick, composed largely of iron pyrites. At some point between 700 and 750 feet a bed of logs 10 or 12 feet thick was penetrated. This clay differed from any other bed struck in the bottoms in that it contained no sand strata, and not even a trace of the "gray sand" found in other wells was noted	785	940
Very fine black sand, with a large percentage of mica in small grains	20	960

The following correlations are suggested for the above record:

Quaternary system:		
Pleistocene series:		
Recent alluvium:	155	155
Tertiary system:		
Eocene series:		
Wilcox group:	245	400
Paleocene series:		
Midway group:		
Porters Creek and Clayton formations:	540	940
Cretacous system:		
Gulf series:		
McNairy (Ripley) formation:	20	960

NOTE: The well was reported to have 4-inch casing to 910 feet. The water rose 7 feet above the surface and the well flowed 16 gallons per minute at the surface. The water had a temperature of 72 degrees Fahrenheit. The well was purchased by the City of Campbell in 1912 and is still used without pumping, by allowing the water to flow into their reservoir. In 1914 the City drilled a new well within 50 feet of the old Lumber Company well and at approximately the same elevation. No log or samples were available from this drilling. The well was 960 feet deep, an 8-inch pipe was set to 400 feet. Below that 6-inch pipe, presumably at 920 feet, was set a 40-foot screen which was attached to the 6-inch pipe and which extended from 920 to 960 feet. The water rose 9 feet above ground level. When pumped at 150 gallons per minute the pumping level was 80 feet or a drawdown of 89 feet.

The top of the Porters Creek formation was suggested by the casing point of 400 feet. The Wilcox sands probably were caving into the hole and the Porters Creek clay would offer a good point at which to case out the caving sand. This reasoning was used in drawing the contact in the Campbell Lumber Company well.

In September of 1955 the Layne-Arkansas Company of Jonesboro, Arkansas completed well No. 3 for the City of Campbell at a depth of 935 feet in the McNairy (Ripley) formation. The static water level was 9 feet below ground surface and the yield 328 gallons per minute with a pumping level of 90 feet. The log of this well is similar to the Campbell Lumber Company well No. 1.

Sample log of the City of Clarkton, No. 1 well. Location: Sec. 22, T. 21 N., R. 10 E., Dunklin County, Missouri. Elevation: 280 feet. Completed in February 1939. Well No. 6 on map, Pl. 1. Mo. G. S. No. 5266.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
No samples	30	30
Sand, coarse, gravel, garnet, feldspar	20	50

Sample log of the City of Kennett, No. 3 well. Location: SE NE NE sec. 2, T. 18 N., R. 9 E., Dunklin County, Missouri. Elevation: 265 feet. Completed in March 1939 by Carloss Well Company of Memphis, Tennessee. Well No. 7 on map, Pl. 1. Mo. G. S. No. 5293.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand and silt. Medium-coarse-grained, angular sand with granite fragments, feldspar, chert fragments, mica	20	20
Sand, medium-coarse, angular, with pink feldspar and lignite. Feldspar and igneous material, approximately 40 percent of sample	40	60
Sand, as above, with much lignite	25	85
Sand, coarse, containing feldspar, rock fragments, and magnetite	15	100
Sand, as above, with a trace of rounded limestone fragments, chert fragments between 110 and 125 feet	50	150
Pebbles of chert, jasper, quartz, feldspar, and igneous fragments. Some fossiliferous chert. Pebbles average ⅛ to ¼ inch in diameter	25	175
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay, white to light gray, plastic, silty in part. The samples contain much recirculated sand	97	272
Sand, polished, angular quartz grains. Some cracked grains. Approximately 5 percent of sample composed of black chert fragments which give a salt and pepper effect	97	369
Clay, light gray, white, some small flakes of mica. The samples contain much recirculated sand. Trace of glauconite at 380 feet and of lignite at 390 feet	26	395
Sand and clay. Sand coarse-grained, angular, polished and clay as above	15	410
Silt and clay, gray silt with small mica flakes, some carbonized plant remains. Some sand streaks at 445, 465, and 475 feet	77	477
Sand, angular quartz grains, some black chert, dark mineral grains, magnetite, and kyanite	108	585
Sand, as above, with streaks of light gray clay	18	603
Sand, as above, with small nodules of manganese and iron oxides, and streaks of gray clay	32	635
Sand, tan, brecciated grains, some dark minerals, several tourmaline grains	40	675
Clay, white and light gray, with streaks of sand. (Much recirculated sand from horizons above)	45	720
Sand, medium-fine-grained, angular, cracked, brecciated quartz grains with some kyanite and black chert grains. Some clay streaks between 755 and 770 feet	80	800
Clay, gray, sandy, with plant remains. Some sand aggregates cemented by pyrite	45	845

Sample log of the City of Kennett, No. 3 well—Continued.

	Thickness, Feet	*Depth, Feet*
Sand, white, angular quartz grains, some opaque, milky quartz grains	10	855
Clay, sandy, gray, with plant remains and small mica flakes	13	868
Sand, medium-fine-grained, angular quartz grains, clear to milky white in color. Some kyanite grains, some siderite spherulites	67	935
Sand, as above, with streaks of light colored clay. Contains limonite and siderite nodules	45	980
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, gray, with plant remains and much siderite; both spherulites and massive gray to tan ankeritic material	5	985
Clay, gray, almost black when wet, contains small quantity of minute flakes of mica, some fine sand grains, and leaf imprints	20	1005
Clay, as above, with siderite and pyrite. Siderite occurs both massive and as spherulites. Some masses of cellular siderite with much glauconite	15	1020
Clay, gray, siderite spherulites, much recirculated sand (over 50 percent)	15	1035
Clay, dark gray, small flakes of mica and some few plant remains	25	1060
Clay, gray, as above, with more than 50 percent white polished, angular sand, probably recirculated material from above	130	1190
Clay, gray, as above, with small flakes of mica. Recirculated sand makes up about 40 percent of the sample	85	1275
Clay, gray, with scattered fragments of foraminifera, crinoids, and spines. Glauconite present in samples at 1290 and 1305 feet	50	1325
Clay, gray, with calcareous sandstone, glauconite, and phosphatic pebbles. (Much of the gray clay is probably recirculated Porters Creek)	10	1335
Clay, gray, micaceous, sandy in part, with some calcareous fossils, crinoid and spine fragments. Trace of glauconite	25	1360
Sand and clay, medium-fine-grained sand, large flakes of muscovite mica, calcareous fossil fragments, chiefly crinoids and spine fragments	20	1380
Sand and clay, highly micaceous and calcareous, fragments of crinoids, foraminifera and spines, and some glauconite grains. These samples contain a large percentage of recirculated Wilcox and alluvial sand	70	1450
Clayton formation:		
Sandy limestone and clay. Limestone, white, fossiliferous, with brown and green glauconite. Clay, gray, micaceous, as above	13	1463
McNairy (Ripley) formation:		
Sand, medium-grained, angular with some glauconite and fossil fragments, chiefly pelecypods	47	1510
Sand, as above, cemented with siderite and calcit. Pelecypod fragments and glauconite grains	10	1520
Marl, tan to gray, sandy, with mica and glaconite. Contains sand lenses. Sand highly micaceous, calcareous, and glauconitic with phosphatic nodules and fish teeth. Below 1550 feet there is much brown altered glauconite in oblong, spindle shaped grains	80	1600

NOTE: The well was cased from the surface to 160 feet with 16-inch casing, and from the surface to 1461 feet 4 inches with 10-inch pipe. Attached to the 10-inch pipe was 78 feet 4 inches of screen with 14 feet 4 inches of lap into the 10-inch pipe. A lead seal was placed at the top of the screen. The bottom of the screen

was at 1525 feet 4 inches. The water rose to 55 feet above ground level, and the well flowed 115 gallons per minute at ground level. A 24-hour pump test gave a yield of 460 gallons per minute with a pumping level of 165 feet or 220 feet of drawdown. The water had a temperature of 82 degrees Fahrenheit.

The City of Kennett has another well 155 feet in depth which obtains its water from the alluvium and which is used as a stand-by. The well was cased from the surface to 120 feet. An 8-inch screen 30 feet long was attached to the casing. The water level was 30 feet from the surface. The well produced 500 gallons per minute.

Sample log of the City of Senath, No. 3 well. Location: SE SW SE sec. 2, T. 17 N., R. 8 E., Dunklin County, Missouri. Elevation: 259 feet. Completed November 1945 by Weldon Well Company of Cape Girardeau, Missouri. Well No. 8 on map, Pl. 1. Mo. G. S. No. 8948.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Silt, brown	15	15
Sand, polished grains, coarse, igneous pebbles	25	40
Clay, brown to buff, lignite, chert	130	170
Sand, polished grains, chert pebbles	25	195
Pebbles, chert and quartz, polished sand grains	15	210
Tertiary system:		
Eocene series:		
Wilcox group:		
Sand, medium-to-fine grains	40	250
Sand, coarse and medium grains, polished	125	375
Sand, as above, chert pebbles	25	400
Sand, as above	100	500
Sand, as above with chert pebbles	15	515
Silt or clay, yellow	25	540
Sand, coarse, some yellow clay	105	645
Clay, gray, lignite	20	665
Silt, gray	40	705
Clay, gray, siderite	30	735
Sand, coarse	15	750
Shale, dark gray	25	775
Sand, coarse, pea gravel, siderite	20	795
Clay, gray	10	805
Sand, coarse, lignite	10	815
Clay, gray	25	840
Sand, medium	60	900
Clay, gray, lignite	40	940
Silt, gray	35	975
Sand, medium-to-coarse	25	1000
Silt, or clay, very fine-grained	150	1150
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, dark gray, micaceous, conchoidal fracture	320	1470
Clay, as above, glauconitic	125	1595
Clayton formation:		
Limestone, white glauconitic	10	1605
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, dark gray	20	1625
Clay, as above, some medium-grained sand	20	1645
Clay, as above	15	1660
Sand, medium-grained	10	1670
Note: Steel line measure 1670 equals 1690, correction	20	1690
McNairy (Ripley) formation:		
Sand, medium-grained (drilled with cable tools)	27	1717

NOTE: Correlations based upon sample examination, drilling time record, and driller's log.

The well was cased with 10-inch pipe from the surface to 165 feet. There was 8-inch wrought iron pipe down to 130 feet with 6-inch pipe from 130 to 1680 feet. The 6-inch pipe was attached to the 8-inch with a swedge nipple. Forty feet of 6-inch, 18 slot brass screen was set at 1717 feet and swedged to the 6-inch pipe. The screen was slotted from 1682 to 1717 feet.

The water rose 73 feet above ground level and had a temperature of 83 degrees Fahrenheit. The well flowed 100 gallons per minute at ground level. On a two hour pump test the yield was 300 gallons per minute with a pumping level of 9 feet or a drawdown of 82 feet.

The City of Senath had two wells, each approximately 150 feet in depth, from which the supply was obtained prior to drilling of well No. 3.

Drilling Time Record of City of Senath, No. 3 well

	Depth in Feet			*Avg. Drilling Time*	
Formation	*From*	*To*	*Interval*	*Minutes per Foot*	*Rock Type*
Recent alluvium	0	165	165	—	No record
	165	210	45	8.3	Sand and gravel
Wilcox gr.	210	725	515	3.9	Sand and silt
	725	730	5	21.0	Clay
	730	740	10	13.0	Sand and clay
	740	850	110	3.0	Shale and sand
	850	855	5	12.0	Sand
	855	1150	295	4.7	Sand and silt
Porters Creek fm.	1150	1240	90	4.0	Clay
	1240	1250	10	14.0	Clay
	1250	1305	55	35.8	Clay
	1305	1330	25	17.4	Clay
	1330	1350	20	38.9	Clay
	1350	1380	30	6.2	Clay
	1380	1465	85	56.7	Clay
	1465	1595	130	4.7	Clay, trace sand
Clayton fm.	1595	1605	10	11.5	Limestone
Owl Creek fm.	1605	1670	65	2.7	Clay and sand
McNairy (Ripley) fm.	1670	1717	47	—	No record

Summary log from samples of, City of Cardwell No. 1 well. Location: NE SW SW sec. 3, T. 16 N., R. 7 E., Dunklin County, Missouri. Elevation: 248 feet. Completed in July 1949 by the Weldon Well Company of Cape Girardeau, Missouri. Well No. 8a on map, Pl. 1. Mo. G. S. No. 10902.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:	160	160
Tertiary system:		
Eocene series:		
Wilcox group:	760	920
Paleocene series:		
Midway group:		
Porters Creek and Clayton formations:	520	1440
Cretaceous system:		
Gulf series:		
Owl Creek? formation:	100	1540
McNairy (Ripley) formation:	230	1770

NOTE: The well was cased with 130 feet of 8-inch pipe with a swedge nipple 12 inches long and 1511 feet of 6-inch pipe perforated for 50 feet. There is no screen data available and the yield is unknown. An electrical log of the hole was made by the Schlumberger Company.

Sample log of the City of Hornersville, No. 2 well. Location: SE SW NE sec. 8, T. 16 N., R. 9 E., Dunklin County, Missouri. Elevation: 246 feet. Completed in April 1946 by Weldon Well Company of Cape Girardeau, Missouri. Well No. 9 on map, Pl. 1. Mo. G. S. No. 9110.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Silt, brown to gray	15	15
Sand, gray and brown, polished grains, igneous fragments	120	135
Gravel	20	155
Gravel and clay	15	170
Boulders	5	175
Clay, dark	5	180
Sand, with clay or silt	35	215
Sand, with chert pebbles	35	250
Tertiary system:		
Eocene series:		
Wilcox group:		
Silt, gray with some sand	110	360
Silt, as above becoming more sandy	100	460
Sand, coarse, polished grains	50	510
Sand, as above, some silt, siderite, and lignite, with chert pebbles	390	900
Sand, coarse, with gray clay, lignite	100	1000
Clay, gray, some sand	125	1125
Sand, polished grains	100	1225
Sand, as above, some buff to brown clay	100	1325
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, brown, and gray	60	1385
Clay, blue-gray, micaceous	200	1585
Clay, as above, glauconitic	45	1630
Clay, blue-gray, glauconitic, calcareous	130	1760
Clayton formation:		
Limestone, glauconitic	10	1770
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, brown, calcareous, fossiliferous	25	1795
McNairy (Ripley) formation:		
Sand, glauconitic, medium-grained, some black asphaltic material	51	1846

NOTE: Correlations based upon sample examination, drilling time record, and driller's log. The well was cased with 10-inch pipe from the surface to 180 feet. From the surface to 110 feet there was 8-inch pipe; and there was 6-inch pipe from 110 to 1890 feet. The 6-inch pipe was attached to the 8-inch with a swedge nipple. Fifty feet of 6-inch No. 18 slot brass screen was set from 1796 to 1846 feet. The screen had 13 feet of blank at the top which extended into the 6-inch pipe. A lead seal was made between the blank screen and 6-inch pipe. The 37 feet of slotted screen extended from 1809 to 1846 feet.

The water rose 81 feet above ground level and had a temperature of 88 degrees Fahrenheit. The well flowed an estimated 150-200 gallons of water per minute at ground level.

The City of Hornersville had a shallow well 50 feet in depth which furnished the supply prior to drilling of well No. 2.

Sample log of the City of Charleston water prospect hole. Location: SW NE SW, sec. 5, T. 26 N., R. 16 E., Mississippi County, Missouri. Elevation: 325 feet. Drilled in 1925 by Cart Contracting Company. Well No. 1 on map, Pl. 1. Mo. G. S. No. 2661.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, angular to sub-rounded grains composed of quartz, feldspar, black chert, fragments of igneous and metamorphic rocks, and iron oxide minerals	115	115
Tertiary system:		
Eocene series:		
Wilcox group:		
Pebbles, sand, and silty clay. Pebbles composed of quartz, granite fragments, chert, limonite, fossiliferous limestone, and quartzite. Sand subangular quartz grains which are probably reworked Wilcox, may be "Lafayette" in part	165	280
Sand, white, polished, angular quartz grains, coarse-grained below 350 feet. Sand contains caved alluvial pebbles	120	400
No samples	400	800

NOTE: Driller reported 15 feet of Paleozoic rock, but no samples were taken. After the above test hole was drilled, two new wells for the city's water supply were completed in 1926. A number 8 screen was set in each well from 340 to 400 feet. One of these wells (No. 2) is still in use.

Since 1926 a Layne-Bowler gravel pack well 400 feet in depth has been completed and has taken the place of one of the wells drilled in 1926. Each of the existing wells was reported to yield in excess of 600 gallons of water per minute.

Sample log of the City of East Prairie, No. 1 well. Location: SW, sec. 25, T. 25 N., R. 15 E., Mississippi County, Missouri. Elevation: 305 feet. Completed in April 1937 by Carloss Well Company of Memphis, Tennessee. Well No. 2 on map, Pl. 1. Mo. G. S. No. 4194.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, coarse, angular, arkosic, with feldspar and igneous rock fragments	45	45
Sand, as above, with "lignite" which shows woody structure but burns with difficulty (may be partly silicified)	15	60
Sand, as above no lignite except at 75 feet	15	75
Sand and small pebbles with igneous rock fragments	25	100
Sand and pebbles, quartz, brown chert, igneous and metamorphic fragments	35	135
Tertiary system:		
Eocene series:		
Wilcox group:		
Sand, white, polished, angular grains. Some pink garnet and black tourmaline; kaolin at 165 feet	30	165
Sand, coarse, angular, polished quartz with some black chert	20	185
Sand, medium-grained angular with some kaolin and silt	40	225
Sand, medium coarse, angular, with some small black chert fragments	65	290
Sand, coarse, white, polished, subangular, with some dark chert fragments	20	310
Clay, white, with fine micaceous sand	7	317

Sample log of the City of East Prairie, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Sand, medium-grained, angular, with small black fragments of chert	48	365
Clay and silt, light grey to white mixed with sand, as above	10	375
Sand, medium-fine-grained, angular, with a trace of clay	25	400
Clay, tan to brown, with plant remains mixed with sand, as above	60	460
No samples	40	500
Clay, grey, sandy	5	505

NOTE: The above well had 317 feet of 8-inch casing and 30 feet of No. 8 Cook screen. The static water level was 7.5 feet and the yield 168 gallons of water per minute with 166.3 feet of drawdown. In 1943 the Weldon Well Company of Cape Girardeau, Missouri completed well No. 2 in the alluvium at a depth of 95 feet, Mo. G. S. Log No. 8315. There was set 67 feet of 10-inch pipe and 8 feet of 8-inch which served as a retainer for the screen packer. Twenty feet of 8-inch screen was sealed to this. The static water level was 6 feet.

Driller's log of the Himmelberger-Harrison Manufacturing Company, No. 1 well. Location: SW SW SE sec. 31, T. 26 N., R. 13 E., New Madrid County, Missouri. Elevation: 301 feet. Completed in the summer of 1902 by Wm. B. Johnson of Memphis, Tennessee. Well No. 1 on map, Pl. 1. Mo. G. S. No. 270.

	Thickness, Feet	*Depth, Feet*
Clay	30	30
Coarse sand	110	140
Gravel	10	150
Gumbo or brown clay	40	190
Brown quick sand	40	230
Gumbo	10	240
Cemented gravel	8	248
Gumbo	197	445
Rock	1	446
Gumbo	20	466
Fine white sand	224	690
Limestone	40	730
Sandstone	15	745
Limestone, full of crevices and badly broken	35	780
The following correlations are suggested for the above log:		
Quaternary system:		
Pleistocene series:		
Recent alluvium:	155	155
Tertiary system?:		
Eocene series:		
Wilcox group:	95	250
Paleocene series:		
Midway group:		
Porters Creek formation:	195	445
Clayton formation:	1	446
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:	244	690
Canadian system:		
Powell? formation:	90	780

NOTE: The well was cased at 690 feet with 6⅝-inch casing. The water rose 18 feet above ground level, and the well flowed 200 gallons of water per minute at ground level.

***Sample log of the Lilbourn Oil Corporation, S. L. Hunter No. 1 well. Location: SW SW SW sec. 18, T. 23 N., R. 14 E., New Madrid County, Missouri. Elevation: 288 feet. Completed in July 1941 by R. B. Winn of St. Elmo, Illinois. Well No. 2 on map, Pl. 1. Mo. G. S. No. 7809.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, coarse, polished grains, arkosic	140	140
Sand, as above, chert pebbles	50	190
Gravel, chert	20	210
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay, gray, micaceous, some sand	75	285
No samples	315	600
Clay, gray, micaceous	35	635
Sand, angular, medium-grained, some gray clay	60	695
Clay, gray, sandy	105	800
Paleocene series:		
Midway group:		
Porters Creek formation:		
Siderite, red, magnetite, gibbsitic? clay	10	810
Clay, gray, much siderite	55	865
Clay, dark gray	135	1000
Clay, gray, sandy, slightly glauconitic	50	1050
Clay, gray, fine-grained sand, glauconite	70	1120
Clayton formation:		
Limestone, fossiliferous, glauconitic	10	1130
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, brown, glauconitic and calcareous	20	1150
McNairy (Ripley) formation:		
Sand, gray, shaly, glauconitic, fossil fragments	100	1250
Sand, medium-to-coarse-grained	35	1285
Sand, as above, calcareous, glauconitic	90	1375
Sand, coarse-grained	30	1405
Chert, leached, sand as above	15	1420
Canadian system:		
Cotter formation:		
Dolomite, with blue, gray, and white dolomoldic chert	35	1455

Sample log of the City of Parma, No. 1 well. Location: NW NW NE sec. 25, T. 23 N., R. 11 E., New Madrid County, Missouri. Elevation: 282 feet. Completed in February 1936 by Carloss Well Company of Memphis, Tennessee. Well No. 3 on map, Pl. 1. Mo. G. S. No. 4216.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Silt, tan, sandy toward base	15	15
Sand, course, subangular, with fragments of feldspar, hornblende, and igneous rock fragments	25	40
Clay, brown, mixed with sand as above	5	45
Sand, coarse, subangular, with feldspar and heavy mineral fragments	35	80
Sand, small pebbles, granite and metamorphic rock fragments, fossiliferous chert and garnet	50	130
Sand, coarse, gritty, with some fragments of dark chert. Smaller grain size than above 50 feet	35	165

Sample log of the City of Parma, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Tertiary system:		
Eocene series:		
Wilcox group:		
Silt, brown, fine-grained, slightly sandy	5	170
Clay, gray to tan, some plant remains at 205 feet	60	230
Medium-fine-grained sand, some tan to gray clay. Some plant remains	45	275
Sand, shaly, gray, micaceous, medium-fine-grained	25	300
Sand, medium-coarse, subangular, quartz sand	50	350
Sand, similar to above with some black chert	10	360
Sand, fine-grained, poorly sorted, with some small mica flakes	20	380
Sand, medium-grained, angular, stained orange colored	35	415
Sand, coarse, with feldspar fragments and schist and granite chips. (May be largely recirculated material.)	10	425
Sand, medium-fine-grained, orange colored, angular, poorly sorted	50	475

NOTE: The well was cased with 415 feet of 8-inch pipe to which was attached 60 feet of screen with a 5 foot blank in upper portion. The water stood 11 feet below ground level, and a pump test yielded 200 gallons per minute with 4 feet of drawdown. The water had a temperature of 60 degrees Fahrenheit.

Sample log of the City of Lilbourn No. 1 well. Location: Near Center, sec. 35, T. 23 N., R. 13 E., New Madrid County, Missouri. Elevation 285 feet. Completed March 1947 by Weldon Well Company of Cape Girardeau, Missouri. Well No. 3a on map, Pl. 1. Mo. G. S. No. 9502.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, gray	15	15
Sand, medium to coarse	115	130
Gravel, chert	70	200
Tertiary system:		
Eocene series:		
Wilcox group:		
Sand and silt, lignite	5	205
As above	60	265
Clay, gray, sand polished	90	355
As above	520	875
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, gray, lignite and siderite	165	940
Clay, gray, sand coarse, lignite	60	1000
Clay, gray, micaceous and silty	55	1055
Clay, as above, glauconitic	125	1180
Clayton formation:		
Limestone, glauconitic, fossiliferous	10	1190
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, gray, sandy and glauconitic	75	1265
McNairy (Ripley) formation:		
Sand, medium to fine pyritic and glauconitic	70	1335

NOTE: The well was cased from the surface to 1,300 feet with 6 inch casing to which is attached 31 feet of screen. The water was reported to flow 45 feet above ground level and had a temperature of 85 degrees Fahrenheit. Surface casing 8 inches in diameter was also set at 240 feet. On a pump test the well produced 100 gallons per minute with a pumping level less than 100 feet below the surface.

***Sample log of the Cordova-Union Oil Corporation, E. Phillips No. 1 well. Location: U. S. Survey No. 97 (SW SW NW sec. 33, T. 23 N., R. 14 E., projected) New Madrid County, Missouri. Elevation: 302 feet. Completed in April 1941 by Bob Milam of Smackover, Arkansas. Well No. 4 on map, Pl. 1. Mo. G. S. No. 6809.**

	Thickness, Feet	*Depth, Feet*
No samples	735	735
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay, gray and light tan, with some leaf prints and plant remains, together with polished, subangular sand and some chert fragments. The chert and part of the sand are recirculated material. A trace of glauconite occurs at 800 feet	180	915
Sand, medium-coarse, angular, crackled grains. The sand has the appearance of having been derived from metamorphic rocks such as schists and gneisses	90	1005
Paleocene series:		
Midway group:		
Porters Creek formation:		
Sand and clay. Sand as described above and probably chiefly recirculated. Clay, dark gray, micaceous, with some plant remains, also brownish-gray, pale greenish-white and pink clay. Some pyrite	80	1085
Clay, gray, with some plant remains and pyrite. Fragments are even-textured and break with shelly fracture characteristic of Porters Creek formation. Contains some large glauconite grains below 1105 feet	125	1210
Clay as described above, fine-grained micaceous sand aggregates, some foraminifera and numerous glauconite grains.		
Note: The Paleocene, Midway, and upper Cretaceous, Owl Creek contact is extremely difficult to define. The samples indicate the contact may occur as high as 1240 feet, no lag in sample return being considered. The electrical log does not define the contact and suggests it may be at 1276 feet. The driller noted a distinct change at 1224 feet	66	1276
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, fine-grained, micaceous, with gray and brown clay. Some calcareous fossil fragments, foraminifera and glauconite. Pelecypod fragments	34	1310
Sand, coarse-to-medium-coarse cracked grains with calcareous fossil fragments (pelecypods and foraminifera) and some glauconite grains	50	1360
Sand, medium sized, crackled grains similar to above with calcareous cementing material, fossil pelecypod fragments, fish teeth, foraminifera, and ostracods	150	1510
Sand, coarse, polished grains with weathered chert fragments below 1540 feet	50	1560
Canadian system:		
Cotter formation:		
Dolomite, brown crystalline, fine-grained residues consist of gray oolitic smooth chert	60	1620
Dolomite, brown crystalline, medium-grained with zones of very coarse crystalline dolomite at 1695 to 1710 and from 1755 to 1775. From 1700 to 1775 gray coarsely crystalline dolomite is interbedded with the dark brown dolomite. Residues show gray oolitic chert. At 1755 to 1775 may be the expression of the "Swan Creek" sandstone	155	1775

Sample log of the Cordova-Union Oil Corporation, E. Phillips No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Jefferson City formation:		
Dolomite, brown crystalline, medium-grained, interbedded with gray crystalline dolomite of the same crystallinity. At 1810 is found a brown quartzose oolitic chert	115	1890
Dolomite, brown crystalline, medium-grained, interbedded, as above, with gray to light gray crystalline dolomite. At 1940 and at 1965 to 1980 calcite and crystalline limestone becomes prominent. Most of the samples show the characteristic brown oolitic chert of the Jefferson City formation	110	2000
Dolomite, brown and red, medium-to-coarse-grained, crystalline, with white and red calcite and crystalline limestone. Residues show dolomoldic chert, translucent reddish-brown chert, and gray oolitic chert	140	2140
Roubidoux formation:		
Dolomite, brown and red, medium-grained, crystalline, with white and red calcite. Calcite percentage less than the interval from 2000 to 2140. Sand horizons from 2170 to 2185, from 2255 to 2285, and from 2335 to 2380 feet. Residues show smooth chert with dolomold zones from 2200 to 2250 feet. White dolomoldic chert is found in the basal sand	240	2380
Ozarkian system:		
Gasconade formation:		
Dolomite, brown crystalline, 10 percent or less white and red calcite. Interval from 2375 to 2400 large amount of smooth chert. Interval from 2400 to 2503 shows a gray quartzose chert	120	2503

NOTE: A Halliburton electrical survey was made of the hole at a depth of 2343 feet. A core was taken from 2340 to 2342 feet 9 inches, recovery being 5 inches of brecciated, chert, and dolomite. A show of oil was reported at 1793-1798 feet. No odor or stains were noted in the samples of cuttings.

Driller's log of the City of New Madrid, No. 1 well. Location: C. SW SE sec. 34, T. 23 N., R. 14 E., New Madrid County, Missouri. Elevation: 295 feet. Well No. 5 on map, Pl. 1.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay	6	6
Sand	109	115

NOTE: The well had 85 feet of casing to which was attached 30 feet of screen. The water level varied with the stage of the Mississippi River and had a range of from 0 to 30 feet beneath the surface. The well produced 400 gallons per minute with not over 10 feet of drawdown.

The City has a second well of the same depth located about 300 feet from well No. 1. Well No. 2 had 95 feet of 8-inch casing to which was attached 20 feet of screen. The yield, water level, and drawdown were similar to well No. 1.

***Sample log of the U. S. Bureau of Mines, R. B. Oliver, Jr., No. 1 well. Location: C. SW SW sec. 29, T. 22 N., R. 11 E., New Madrid County, Missouri. Elevation: 278 feet. Completed May 25, 1945 by Pioneer Drilling Company of Mt. Vernon, Illinois. Well No. 6 on map, Pl. 1. Mo. G. S. No. 8882.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, medium-to-coarse, chert fragments, igneous particles	133	133

Sample log of the U. S. Bureau of Mines, R. B. Oliver, Jr., No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay, blue plastic	247	380
Clay, blue plastic, slightly sandy	40	420
Clay and sandy clay	330	750
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, gray to black, somewhat micaceous	230	980
Clay, as above, glauconitic from 975 feet, glauconite increasingly abundant in lower portion, somewhat sandy from 1020 to 1075 feet	95	1075
Clayton formation:		
Limestone and marl, very glauconitic	10	1085
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, brown to blue, micaceous, glauconitic, slightly marly and sandy	45	1130
McNairy (Ripley) formation:		
Sand, medium-to-fine, micaceous, much pyrite from 1240 to 1296 feet	166	1296
Canadian system:		
Jefferson City formation:		
Dolomite, gray and brown crystalline. Residue small, chert, gray and brown dolomoldic. Some oolitic chert and free white silicified oolites	34	1340
Dolomite, brown, crystalline. Residue about 25 percent. Chert brown and white, smooth, oolitic, some quartz and sand	50	1390
Dolomite, brown crystalline. Residues small, smooth gray and white chert, oolitic. Some finely porous and dolomoldic. A little pyrite in lower 25 feet	110	1500
Dolomite, brown to gray, crystalline with small amounts of calcite. Residue small, black chert, dolomoldic and and pyrite	15	1515
Dolomite, brown, coarsely crystalline, vuggy. Small residue, black porous chert and gray chert. Some oolitic and dolomoldic	25	1540
Dolomite, brown crystalline. Residue about 20 percent, gray and black porous silt or silica, a little white dolomoldic silica and some black shale	75	1615
Limestone, brown, dense to finely crystalline. Residue about 20 percent as above with a little very fine sand and some quartz	35	1650
Roubidoux formation:		
Dolomite, brown and gray, crystalline to dense. Residue, gray porous silt, oolitic and sandy chert	45	1695
Dolomite, brown, crystalline, some vuggy. Residues about 20 percent, rounded sand, sandy and oolitic chert, white and tan oolite in chert	160	1855
Dolomite, brown, crystalline, some calcite. Residues about 20 percent, smooth gray chert, oolitic, dolomoldic, and sandy. Sphalerite at 1935 feet	95	1950
Dolomite, brown, crystalline. Residues 20 to 40 percent, rounded sand, quartz, sandy chert	50	2000
Dolomite, brown, crystalline. Residues 20 percent, siltstone, sand, sandy chert and smooth gray-blue chert, some free brown silicified oolites	45	2045

Sample log of the U. S. Bureau of Mines, R. B. Oliver, Jr., No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Ozarkian system:		
Gasconade-Van Buren formations, undifferentiated:		
Dolomite, gray to brown, crystalline to dense. Residue small, siltstone, smooth gray chert, dolomoldic, white chert and quartz	95	2140
Dolomite, gray to light brown. Residue about 20 percent, smooth white dolomoldic chert, tan oolites in chert, quartz	90	2230
Gunter member:		
Dolomite, gray to brown, crystalline. Residues small, rounded sand, gray dolomoldic and sandy chert	60	2290
Eminence formation:		
Dolomite, dark gray to brownish-gray, crystalline. Residues average less than 10 percent, gray chert, pyrite, quartz and free white oolites. Galena at 2390 feet	180	2470
Potosi formation:		
Dolomite, brown, coarsely crystalline. Residues small, quartz, banded quartz druse, brown granular silica. Core No. 1, from 2717 to 2720 feet, 3 feet of recovery; dolomite, dark brown, crystalline, slightly vuggy, vugs lined with quartz crystals and kaolinite (?)	305	2775
Cambrian system:		
Elvins group:		
Derby-Doerun and Davis formations (undifferentiated):		
Dolomite, brown, coarsely crystalline and gray crystalline to dense. Residues small, sand, quartz, pyrite, silt, dark brown granular silica, and kaolinite (?). Core No. 2, from 2900 to 2905 feet, 4 feet of recovery; dolomite, almost black, crystalline, slightly vuggy. Residue very small, dark brown to black porous silt, with little quartz and kaolinite(?). Core No. 3, from 2952 to 2967 feet, 9 feet of recovery; dolomite cream, coarsely crystalline, slickensided(?) some black crystalline with calcite veins. Residue very small, white, lace-like silica, pyrite, few medium sized sand grains rounded, some quartz and brown granular silica. Core No. 4 from 3085 to 3090 feet, 1 foot 3 inches of recovery; dolomite, light gray, coarsely crystalline. Residue very small, gray silt, pyrite, very fine rounded sand grains, pale green shale	395	3170
Dolomite, gray, crystalline, vuggy, some calcite veinlets below 3250 feet. Residues very small, waxy green shale, glauconite, extremely fine sand, pyrite, gray silt, doubly terminated quartz crystals, kaolinite(?)	220	3390
Bonneterre formation:		
Dolomite, brown to gray, crystalline, some calcite. Residues small, shale black and brown, gray lace-like silica	110	3500
No samples	27	3527
Dolomite, brownish-gray, crystalline, some pink. Residues small, green dolomoldic shale, gray shale	103	3630
Core No. 5, from 3630 to 3636 feet, recovery 3 feet 6 inches. Dolomite, cream, finely crystalline to dense, some pink. Residue extremely small, fine sand grains, kaolinite (?), a few specks of red hematite, smooth white chert	6	3636
Dolomite, gray to brown, crystalline. Residue small, black shale	9	3645
Dolomite, gray to brown, crystalline. Residue about 30 percent, gray to greenish-gray clay with mica; appears to be metamorphic	10	3655
Dolomite, gray dense. Residues small, brown and black shale	35	3690

Sample log of the U. S. Bureau of Mines, R. B. Oliver, Jr., No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Dolomite, gray, dense. Residues clay with mica; appears to be metamorphic	28	3718
Core No. 6, from 3718 to 3728 feet, recovery 5 feet. Dolomite, cream-gray, finely crystalline to dense with black shale bands, one nodule of dark brown sub-translucent chert. Residue small, black and gray shale, quartz and red hematite	10	3728

NOTE: Drilling time was kept for the entire depth below 195 feet. An electrical survey was made from 183 to 1313 feet and a caliper log made from 100 to 752 feet. A total of 141 bits were used in the drilling.

The well was cased with 15½-inch pipe from the surface to 183 feet and with 10¾-inch casing to 1312 feet. Between depths 2920 and 3009 feet, water was encountered which flowed 50 feet above ground level at an estimated 700 gallons per minute. After several failures to shut off the water by cementing, 8¾-inch casing was set from the surface to 3091 feet. Another flow of water was encountered at 3500 feet, and circulation was lost at several points below that depth. Several attempts were made to cement off this water but all failed, making it necessary to set a string of 4-inch standard pipe at 3728 feet.

Drilling Time Record of U. S. Bureau of Mines, Oliver No. 1 well

	Depth in Feet			*Avg. Drilling Time*	
Formation	*From*	*To*	*Interval*	*Minutes per Foot*	*Rock Type*
Recent alluvium	0	133	133	—	No record
Wilcox gr.	133	195	62	—	No record
	195	210	15	13.1	Clay
	210	380	170	4.4	Clay
	380	750	370	0.7	Clay, sandy
Porters Creek fm.	750	860	110	1.3	Clay
	860	1030	170	5.5	Clay
	1030	1075	45	0.6	Clay, slightly sandy
Clayton fm.	1075	1085	10	5.1	Limestone and marl
Owl Creek fm.	1085	1130	45	0.9	Clay, slightly sandy
McNairy (Ripley) fm.	1130	1200	70	0.6	Sand
	1200	1296	96	5.0	Sand and pyrite
Jefferson City fm.	1296	1311.5	15.5	18.7	Dolomite
	1311.5	1360	48.5	6.7	Dolomite
	1360	1650	290	49.7	Dolomite and chert
Roubidoux fm.	1650	1920	270	36.5	Dolomite
	1920	1970	50	88.7	Dolomite
	1970	2007	37	103.2	Dolomite
	2007	2028	21	74.6	Dolomite
	2028	2035	7	122.9	Dolomite
	2035	2045	10	62.0	Dolomite
Gasconade—	2045	2105	60	53.9	Dolomite
Van Buren fms.	2105	2168	63	89.8	Dolomite
	2168	2230	62	65.0	Dolomite
Gunter mem.	2230	2290	60	50.5	Dolomite
Eminence fm.	2290	2470	180	44.6	Dolomite

Drilling Time Record of U. S. Bureau of Mines, Oliver No. 1 well—Continued.

Formation	*Depth in Feet* From	To	*Interval*	*Avg. Drilling Time* Minutes per Foot	*Rock Type*
Potosi fm.	2470	2696	226	40.6	Dolomite
	2696	2765	69	97.8	Dolomite
	2765	2775	10	70.2	Dolomite
Elvins gr.	2775	2828	53	72.7	Dolomite
	2828	2945	117	45.5	Dolomite
	2945	2951	6	0	Lost circulation
	2951	2984	33	17.3	Dolomite
	2984	3009	25	5.7	Dolomite
	3009	3018	9	—	No record
	3018	3327	309	25.2	Dolomite
	3327	3389	62	12.2	Dolomite
Bonneterre fm.	3389	3630	241	21.1	Dolomite
	3630	3728	92	44.8	Dolomite

***Driller's log of the J. J. Hobbitzel, No. 1 well. Location: NW cor., sec. 23, T. 21 N., R. 10 E., New Madrid County, Missouri. Elevation: 266 feet. Completed in 1911 by Wm. Shriver of St. Louis, Missouri and John Sullivan of Wichita, Kansas. Well No. 7 on map, Pl. 1.**

NOTE: The following information in regard to this well appears in the files of the Missouri Geological Survey:

"At 90 feet we found a well-preserved walnut log. At 300 feet we had cave that took three large loads of wood to save the derrick. At 600 feet a layer of coal, but not in paying quantities. At 1200 feet the first formation a sand stone rock two and a half feet. After going through the rock one of the greatest artesian wells you ever saw. It seemed we had struck the bed of the ocean as the drill wanted to go on down.

We drew the pipe as much as we could and quit. Going down about 900 feet we found as well-preserved oyster shells as you could get out of the ocean."

There is a possibility that the artesian flow of water at 1200 feet might have been in the McNairy (Ripley) sand.

Summary log from samples, City of Gideon No. 4? well. Location: NE SW SE, sec. 13, T. 21 N., R. 10 E., at water tower on west side of Gideon, New Madrid County, Missouri. Elevation: 268 feet. Completed July 6, 1949 by Weldon Well Company of Cape Girardeau, Missouri. Well No. 7a on map, Pl. 1. Mo. G. S. No. 10903.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:	251	251
Tertiary system:		
Eocene series:		
Wilcox group:	554	805
Paleocene series:		
Midway group:		
Porters Creek and Clayton formations:	330	1135
Cretaceous system:		
Gulf series:		
Owl Creek formation:	60	1195
McNairy (Ripley) formation:	135	1330

NOTE: The well was cased with 126 feet of 10-inch pipe and 1189 feet of 8-inch pipe which was perforated at 1300 feet. The screen was 70 feet and 8 inches of Johnson Evidur (18 slot). The well flowed natural at 176 gallons per minute. With the bowl assembly set at 90 to 100 feet pump went on air at 300 g.p.m. Later, pump

assembly was lowered and well was pumped at 381 g.p.m. for 24 hours with 400 g.p.m. near end of test.

In 1955, the Layne-Arkansas Company of Jonesboro, Arkansas, completed the City of Gideon well No. 5 at a depth of 1308 feet in the McNairy (Ripley) formation. Upon completion, the well flowed 720 g.p.m. and the water level rose to 39 feet above the ground level.

Sample log of the City of Portageville, No. 2 well. Location: SW SE SW sec. 30, T. 21 N., R. 13 E., New Madrid County, Missouri. Elevation: 268 feet. Completed in July 1941 by Carloss Well Company of Memphis, Tennessee. Well No. 8 on map, Pl. 1. Mo. G. S. No. 6986.

	Thickness, Feet	*Depth, Feet*
Quarternary system:		
Pleistocene series:		
Recent alluvium:	192	192
Tertiary system:		
Eocene series:		
Wilcox group:	358	550

NOTE: The above correlation is made from 7 samples of cuttings and an incomplete driller's log.

The well was cased from the surface to 508 feet with 8-inch pipe to which attached 30 feet of 8-inch screen. The water level was 19 feet below the surface when the pump was idle. When pumped at 100 gallons per minute there was 50 feet of drawdown.

In 1954 the City of Portageville No. 3 well was completed by Grady Gentry of Dyersburg, Tennessee, at a depth of 120 feet in the alluvium. A yield of 450 gallons per minute with 4.6 feet of drawdown from a static water level of 14 feet was reported upon completion of the well.

***Sample log of the Strake Petroleum Incorporated, T. P. Russell No. 1 well. Location: 1310 feet north and 360 feet east of the center of the south line of sec. 24, T. 19 N., R. 11 E., Pemiscot County, Missouri. Elevation: 271 feet. Completed in September 1941 by Taylor Drilling Company of Centralia, Illinois. Well No. 1 on map, Pl. 1. Mo. G. S. No. 7222.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, medium-coarse, arkosic, with many fragments of chert, metamorphic, and igneous rocks	60	60
Sand, coarse, with some small pebbles, much feldspar and many igneous rock fragments	30	90
Pebbles and gravel of quartz, chert, granite, basic igneous, and metamorphic rocks. Becomes coarser grained below 120 feet	50	140
No samples	470	610
(The base of the alluvium as taken from the driller's log is at 215 feet)		
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay, gray, with mica and fine-grained angular crackled quartz sand	120	730
Clay, black, with leaf prints and plant remains	15	745
Sand, medium-coarse, crackled, angular quartz grains, with some gray clay	30	775
Clay, gray with some crackled, angular quartz sand	30	805
Clay, white, with some sand	25	830
Clay, gray, with siderite concretions	5	835

Sample log of the Strake Petroleum Incorporated, T. P. Russell No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Clay, gray, with lignite	15	850
Clay, gray	15	865
Clay, gray, sandy, micaceous	45	910
Marl, gray; effervesces vigorously in dilute HCl. Becomes somewhat sandy below 940	75	985
Sand, coarse, polished, subangular crackled grains (Basal Wilcox sand zone)	135	1120
Clay, gray, pyritic (drilling time and electrical log show a change at 1200 feet)	80	1200
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, dark gray, somewhat micaceous, some siderite concretions between 1200 and 1300 feet	310	1510
Core No. 1—clay, gray, very compact, micaceous, core recovery 11 feet	11	1521
Clay, gray as above, containing a small quantity of glauconite from 1555 to 1570 feet		
Core No. 2 taken from 1581 to 1596 feet, full recovery, core contains small calcareous foraminifera in gray clay	89	1610
Clay, gray, with some glauconite and with small coiled calcareous foraminifera and ostracod fragments	19	1629
Clayton formation:		
Limestone, gray, very fossiliferous with pelecypod fragments; contains glauconite and sand grains	2	1631
Core No. 3—taken from 1631 to 1641, complete recovery Limestone, as above	½	1631½
Clay, gray, sandy, more than 50 percent green glauconite grains	½	1632
Limestone, gray, fossiliferous	2	1634
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, brown, very micaceous, much brown glauconite, prints of pelecypods and gastropods in clay, some calcareous fossils, a few fragments of lignite annd pyrite	5	1639
McNairy (Ripley) formation:		
Sandstone, fine-grained, angular crackled grains with glauconite and gray shale. Some calcareous fossil fragments	2	1641
Core No. 4—taken from 1641 to 1659, recovered from 1653 to 1654.		
Sandstone, as above	18	1659
Core No. 5—taken from 1659 to 1679, recovery 5 feet Sandstone, as above	20	1679
Sandstone, as above, cores: No. 6, 1713 to 1731, 2 feet of recovery; No. 7, 1731 to 1750, 9 feet of recovery; No. 8, 1790 to 1808, 1 foot recovery	129	1808
Sandstone, coarse-grained, angular, polished, crackled grains	57	1865
Sandstone, fine-grained, angular quartz sand with some siderite and pyrite cementing the grains	39	1904
Sandstone, hard, very calcareous, very fine-grained, glauconitic	6	1910
Clay or marl, sandy, calcareous, many shell and foraminifera fragments	113	2023
Sandstone, medium-grained, angular grains, some gray clay. Core No. 9, 2023 to 2040, recovery 17 feet	32	2055
Conglomerate, rounded and polished pebbles of black chert and quartz	5	2060
Ozarkian system:		
Eminence or Potosi formation:		
Dolomite, white, crystalline and dense, some vuggy	14	2074
Core, dolomite white, dense with some crystalline, vuggy	22	2096

Sample log of the Strake Petroleum Incorporated, T. P. Russell No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Dolomite, white, coarsely crystalline, some pyrite	44	2140
Core, dolomite, gray-white, crystalline	18	2158
Dolomite, gray-tan to pink, coarsely crystalline and white, very dense almost lithographic, a little flaky silica in residues	107	2265
Core, dolomite, gray-white, crystalline, a little galena, sphalerite and chalcopyrite	5	2270
Dolomite, gray crystalline, some dense, almost lithographic white	45	2315
Dolomite, cream-tan to pink crystalline	18	2333
Core, dolomite, gray-white, crystalline, has appearance of a marble, is slickensided and sheared	5	2338
Dolomite, cream-gray to pink, crystalline, residue contains a few quartz dolomolds and quartz crystals, some metamorphic? minerals, 2425-2450	242	2580
Dolomite, white and pink coarsely crystalline, some dark gray and brown. Residue small, finely porous silica, pyrite and brown shale	70	2650
Dolomite, white to red, coarsely crystalline. Much basic dyke material, brown mica, fluorite, serpentine, chlorite and hornblende	50	2700
Dolomite, flesh colored, coarsely crystalline	20	2720
Dolomite, brown medium crystalline to coarsely crystalline, some almost black dolomite	92	2812
Cambrian system:		
Elvins group?:		
Doerun, Derby and Davis formations:		
Core, dolomite, and limestone, dense white with stringers of red and gray. Some parts coarsely crystalline, some green basic rock	9	2821
Limestone, dense, white, gray and red. Much basic dyke material 2835-2860, mica, talc, kaolin?	99	2920
Dolomite, dark gray and black, medium crystalline and pyritic	30	2950
Dolomite, black, medium crystalline, pyritic. Many lingula brachiopods at 3000	52	3002
Core, dolomite, black medium crystalline. Some black shale partings and white dolomite veinlets	5	3007
Dolomite, black medium crystalline. Some black shale partings	63	3070
Bonneterre formation:		
Shale, black, dolomitic and slightly calcareous. Dike material 3100-3130. *Acrotreta* 3165, *Pseudoagnostids* 3215	159	3229
Core, shale, black, dolomitic and calcareous, containing many fossils at 3231, *Coosella*	6	3235
Shale, as above, lingulas and trilobites at 3435, some serpentine at 3650	883	4118
Core, shale as above, containing brachiopods and trilobites	10	4128
Shale, as above, some dike rock 4250 to 4275	382	4510
Limestone, white, very finely crystalline and glauconitic. Fossils, trilobites and brachiopods 4520—4535. Quartzitic in lower 25 feet	120	4630
Dolomite, light gray, finely crystalline, containing fine sand	20	4650
Lamotte? formation:		
Quartzite, dolomitic, light gray	67	4717
Core, quartzite, dolomitic, very fine-grained, light gray	2	4719
Quartzite, as above	21	4740

NOTE: The cores from this well contained fossils which were identifiable and, therefore, constituted an extremely important record of the age of several of the formations in the area. The following is quoted from a letter to the Missouri Survey

written on February 12, 1942 by Dr. L. W. Stephenson of the United States Geological Survey:

"The larger fossils found in the upper part of core No. 3 were submitted to Dr. Julia Gardner, and the Foraminifera to Mr. L. G. Henbest; their conclusions are incorporated in my report. You will note that the fossils from the upper part of core No. 3 indicate with reasonable certainty that the containing rock belongs to the Midway group (Paleocene); the lower part of the same core is of upper Cretaceous age and is referred questionably to the Owl Creek formation (Upper Cretaceous). The Cretaceous-Tertiary contact therefore was cut by this core.

Upper part of core No. 3, depth 1631 feet—1641 feet.

This part of the core is divisible into two facies, an upper or greensand facies, and a lower or limestone facies. Dr. Julia Gardner has examined the larger fossils from both facies and reports as follows:

Greensand facies:

Ostrea pulaskensis Harris—Conclusive evidence of the Midway age of the greensand facies.

Limestone facies:

Nuculana sp. cf. *N. eoa* (Gardner)
Cucullaea sp.
Ostrea sp.
Crassatellites sp.
Venericardia? sp.
Indet. venerids

Turritella sp. possibly of the group of *T. mortoni* Conrad *Age.*—The shells are too poorly preserved to permit an assured age determination but there is no species included which would be out of place in a fauna of Midway age. The *Nuculana* which resembles *N. eoa* of the lower Midway fauna of Texas, the small, *Venericard*-like molds and the *Turritella* with an overhanging anterior keel are all most closely associated with faunas of Midway age.

Mr. Henbest reports on the Foraminifera as follows:

The 2 specimens of Foraminifera of the family *Lagenidae* from the core from depth 1631-1641, Strake-Russell Well No. 1, sec. 24, T. 19 N., R. 11 E. Pemiscot County, Missouri, are species of *Planularia* and are probably new. They indicate probable Paleocene or Eocene Age, but this is not at all assured.

Lower part of core No. 3, depth 1631 feet—1641 feet.

Highly calcareous, slightly glauconitic, compact sand containing a high percentage of ferruginous, water-worn grains and pellets, mostly oxidized, but in parts of the rock gray and unoxidized; the oxidized grains and pellets exhibit a conspicuous, bright-brownish or bronzy sheen. Contains scattered fragments of fossils mostly in the form of rusty molds, but includes some shell material, among which are recognized:

Annelida:

Hamulus onyx Morton

Pelecypoda:

Inoceramus? sp. (young indiv.)
Exogyra costata Say (fragments)
Crassatella cf. *C. vadosa* Morton (fragment).

Geologic position: Upper Cretaceous (Owl Creek formation?).

Part of Core No. 6, depth 1713'—1731':

Gray calcareous, glauconitic, finely micaceous, fossiliferous sandstone.

Recognized:

Pelecypoda:

Breviarca aff. *B. cuneata* Gabb
Trigonia aff. *T. eufaulensis* Gabb
Pecten (*Camptonectes*) sp. (Small)
Anomia argentaria Morton? (young indiv.)
Cardium sp.
Tena parilis Conrad
Legumen sp. (fragment)
Linearia sp. (large, probably undescribed)
Corbula sp.
An unidentified pelecypod

Gastropoda:
Polinices? sp. (young indiv.)
Turritella trilira Conrad
Seminola solida Wade
Bellifusus? sp. (young, incomplete)

Geologic position: Upper Cretaceous, probably Ripley formation, possible Owl Creek formation.

Part of core No. 7, depth 1731 feet—1750 feet:

Gray argillaceous, micaceous sand containing scattered soft fragments of shells, including a few poorly preserved specimens of *Turritella trilira* Conrad."

The fossils noted in the Cambrian system were tentatively identified by Dr. Josiah Bridge of the United States Geological Survey. Bridge stated orally that the trilobites in the core from 3229 to 3235 feet were upper Cambrian and were known to occur in outcrops of lower Bonneterre in Missouri and the Nolichucky shale of the Appalachian Valley area of eastern Tennessee.

The well was cased at 2131 feet with 7 inch pipe. At 2158 feet circulation was lost, and at 2208 feet the well was flowing 150 gallons of water per minute with a temperature of 92 degrees Fahrenheit and an air temperature of 95 degrees Fahrenheit. The water had an odor of hydrogen-sulphide gas. Circulation was regained after 5 squeeze cementing operations. These operations required 523 sacks of cement, 150 pounds of cellophane, 5 loads of sawdust, 42 bales of fibrotex, and 17,000 pounds of cotton seed hulls.

Drilling time for the hole and a driller's log were kept. The Schlumberger Well Surveying Corporation made an electrical survey of the hole from 383 to 2152 feet.

Sample log of the City of Hayti, No. 4 well. Location: NE SW SW Sec. 34, T. 19 N., R. 12 E., Pemiscot County, Missouri. Elevation: 270 feet. Completed in January of 1947 by Weldon Well Company of Cape Girardeau, Missouri. Well No. 2 on map, Pl. 1. Mo. G. S. No. 9422.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, brown	25	25
Sand, coarse, polished grains, igneous chips	35	60
Sand and gravel, coarse	35	95
Sand, coarse, polished grains	75	170
Gravel, chert and sand	40	210
Tertiary system:		
Eocene series:		
Wilcox group:		
Sand, clay and lignite	30	240
Sand, angular, medium to fine grains	90	350
Clay, brown, some silt	150	500
Sand, some silt	60	560
Sand, medium to fine grained	420	980
Sand, some silt	15	995
Sand, coarse, pyritic	25	1020
Clay, brown to black, sandy	105	1125
Sand, medium grained, pyritic	135	1260
Sand, coarse, pyritic	90	1350
Sand, medium grained	185	1535
Paleocene series:		
Midway group:		
Porters Creek formation:		
Silt, gray, micaceous, sandy	130	1665
Clay, blue-gray, micaceous	145	1810
Clay, as above, glauconitic, sideritic	40	1850
Clay, blue-gray, micaceous, glauconitic	120	1970

Sample log of City of Hayti, No. 4 well—Continued.

	Thickness, Feet	*Depth, Feet*
Clayton formation:		
Limestone, white, glauconitic and fossiliferous		
Cretaceous system:		
Owl Creek formation:		
Sand and clay, glauconitic, fossiliferous	30	2000
Sand and silt, glauconitic	20	2020
McNairy (Ripley) formation:		
Sand, glauconitic	5	2025
Sand, interbedded with clay, glauconitic	35	2060
Sand, as above, some siderite	80	2140
Clay, slightly sandy	13	2153

NOTE: Twelve and one-half inch pipe was set at 225 feet. A 10-inch pipe was set at 200 feet. An 8-inch pipe was set from 200 feet to 1050 feet. A 6-inch pipe was then set at 2130 feet and swedged to the 10-inch pipe at 200 feet. The lower 70 feet of 6-inch pipe was perforated and 70 feet of 6-inch screen was set opposite the perforations. The well flowed 125 gallons per minute. Temperature of water was 94.5 degrees Fahrenheit. Drilling time was recorded for the entire depth.

The City of Hayti has three wells which produced from the alluvium at a depth of 100 feet. Well No. 3 is reported to produce 250 gallons per minute.

Sample log of the City of Deering, No. 2 well. Location: SE SW SE sec. 17, T. 18 N., R. 11 E., Pemiscot County, Missouri. Elevation: 257 feet. Completed in June 1941 by Carloss Well Company of Memphis, Tennessee. Well No. 3 on map, Pl. 1. Mo. G. S. No. 6910.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, gray. Some sand, arkosic	20	20
Sand, coarse-to-medium, arkosic	70	90
Gravel, coarse, consisting of chert quartz, igneous pebbles garnet and feldspar, some lignite	10	100
Clay, tan, same polished and angular sand	20	120
Sand, coarse with chert pebbles, quartzite, feldspar and igneous chips	55	175
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay, white, (3 samples)	239	414
Sand, white, crackled grains, some black chert	116	530
Sandy clay and clay with leaf prints, kyanite, staurolite	180	710
Sand, white, coarse	110	820
Clay, gray and brown, sandy, with leaf prints. Some siderite	200	1020
Clay, gray and white with leaf prints	80	1100
Clay as above with siderite concretions	20	1120
Sand, white, coarse	150	1270
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, dark gray, micaceous, with much recirculated sand	330	1600
Clay, as above, very little sand	35	1635
Clay, gray, micaceous	57	1692
Clay, as above, calcareous	20	1712
Clay, gray and brown	35½	1748½

NOTE: The well was cased from the surface to 196 feet with 8-inch line pipe and from 153 feet 5 inches to 1214 feet with 6-inch line pipe. The 6-inch pipe extended 42 feet 7 inches into the 8-inch pipe and the lap was sealed at the top with lead. A

6-inch Cook screen was attached to the 6-inch line pipe and extended from 1214 to 1255 feet. A 6-inch pipe 23 feet 2 inches long was attached to the bottom of the screen. At the top of the pipe was a wooden wash plug. A back pressure valve was set in a shoe at the bottom of the 6-inch pipe at a depth of 1278 feet. The well flowed 110 gallons per minute 5 feet above ground level.

Driller's log of the Wisconsin Lumber Company well at Deering. Location: NE cor. sec. 20, T. 18 N., R. 11 E., Pemiscot County, Missouri. Elevation: 257 feet. Completed in January 1913 by Thomas Fleming. Well No. 4 on map, Pl. 1.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Gumbo	15	15
Sand	30	45
Sand and gravel	40	85
Coarse gravel	5	90
Soft blue clay	7	97
Coarse sand	63	160
Soft rock	1	161
Gravel	10	171
Hard blue clay	6.5	177.5
The foregoing represents the 10-inch casing.		
Tertiary system:		
Eocene series:		
Wilcox group:		
Hard blue clay	62.5	240.0
Sand	3.1	243.1
Hard clay	20.1	263.2
Hard clay	14.7	277.9
Sand	4.0	281.9
Hard clay	19.1	301.0
Pipe clay	112.3	413.3
Soft clay and sand	21.6	434.9
Sand (little clay)	20.1	455.0
Sand	19.7	474.7
Coarse sand	38.3	513.0

Driller's log of the City of Caruthersville, No. 3 well. Location: C. SW sec. 16, T. 18 N., R. 13 E., Pemiscot County, Missouri. Elevation: 270 feet. Completed in March 1943 by Carloss Well Company of Memphis, Tennessee. Well No. 5 on map, Pl. 1. Mo. G. S. No. 8149.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, sandy	25	25
Sand, coarse, water-bearing	68	93
Sand, coarse. Gravel boulders	85	178
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay	7	185
Sand, fine with lignite	94	279
Gumbo	4	283
Sand, white, fine, water-bearing	137	420
Clay, sandy	10	430
Sand, medium-to-fine, water	144	574
Clay, sandy	88	662
Clay, sandy, very hard packed	20	682

Driller's log of the City of Caruthersville, No. 3 well—Continued.

	Thickness, Feet	*Depth, Feet*
Shale and soapstone with streaks of hard sand	39	721
Rock, hard, boulders	18	739
Clay, sandy	41	780
Sand, medium-to-fine-grained, hard packed, water-bearing	188	968
Clay, sandy, hard	82	1050
Shale or gumbo, very hard	21	1071
Clay, sandy, light gray	29	1100
Sand, white, medium-to-fine	31	1131
Clay, light gray, hard and shaly with streaks of sand	89	1220
Sand, white, medium-to-fine	110	1330
Sand, as above, grain size more even	49	1379
Gumbo, or shale	1	1380

NOTE: Twelve inch surface pipe was set at 182 feet 10 inches. Fifty feet of 8-inch screen was set 10 feet above bottom of hole. The well produced 500 gallons per minute with 18.6 feet of drawdown from a static water level of 4.6 feet. Temperature of water was 80 degrees Fahrenheit.

The City Well No. 2 was completed to a depth of 812 feet by the same contractor in 1922. Fifty feet of Cook screen was set on bottom. This well produced 400 gallons per minute with 42 feet of drawdown from a static level of 21 feet. In 1933 Carloss rehabilitated well No. 1 which originally was drilled to 1548? feet around 1912. At that time the well was developed at a depth of about 1000 feet. By 1933 the screen had deteriorated to such an extent that it could not be pulled. The casing was then perforated just above 800 feet, and a Cook screen set at that depth. Other wells at Caruthersville are the Missouri Power Company, 489 feet deep, and the Ice Factory, 715 feet deep, which was developed by setting a screen at 416 feet.

***Sample log of the O. W. Killam, K. Pattinson No. 1 well. Location: 2175 feet east and 330 feet north of the southwest corner of sec. 33, T. 18 N., R. 13 E., Pemiscot County, Missouri. Elevation: 263 feet. Completed in November 1941 by T. J. Conway of Kilgore, Texas. Well No. 6 on map, Pl. 1. Mo. G. S. No. 7324.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, gray, plastic	30	30
Sand, coarse, polished grains, igneous chips	90	120
Sand, as above, with pea gravel	25	145
Gravel	40	185
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay, gray to brown, plastic	70	255
Clay, greenish-gray, sandy	390	645
Clay, as above, lignite	55	700
Sand, fine with streaks of clay	65	765
Sand, medium-to-coarse, subangular	30	795
Clay, light gray, sandy, calcareous, some lignite and pyrite	55	850
Clay, light gray, sandy	105	955
Sand, medium-to-coarse, polished grains	90	1045
Clay, brown, green and gray, calcareous and lignitic	50	1095
Clay, as above, non-calcareous	50	1145
Sand, medium-to-fine-grained	30	1175
Clay, light gray, sandy	95	1270
Sand, medium-to-fine-grained	135	1405
Clay, greenish-brown, sandy, lignitic	125	1530

Sample log of the O. W. Killam, K. Pattinson No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, blue-gray, conchoidal fracture, siderite from 1873 to 1875 feet	470	2000
Clay, as above, glauconitic; siderite from 2070 to 2078 feet	180	2180
Clayton formation:		
Limestone, white, glauconitic and fossiliferous	10	2190
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Shale, brown, glauconitic	4	2194
McNairy (Ripley) formation:		
Sand, glauconitic	29	2223
Shale, calcareous, sandy and glauconitic, driller reports "lime streaks" 2294-96 and 2393-95	257	2480
Shale, sandy, calcareous, some siderite, driller reports "lime streaks" 2540-43	63	2543
Shale, sandy, calcareous	47	2590
Shale, brown to black, micaceous, plastic	122	2712
Cambrian system:		
Bonneterre formation:		
Shale, black, hard, dolomitic and calcareous	383	3095
Cored from 2718 to 2731 feet, recovery 10 feet 8 inches		
Core, shale as above, igneous material	16	3111
Shale, black, hard, dolomitic	204	3315
Shale, as above, some igneous material	30	3345

NOTE: This hole was lost when the surface casing collapsed. Drilling time is available from 2091 to 2731 feet, and a driller's log was kept for the entire footage drilled. Correlations are based upon sample examinations, driller's log, drilling time, and interpretations made by geologists at the well during the drilling.

Drilling Time Record of O. W. Killam, K. Pattinson No. 1 well

Formation	*Depth in Feet*			*Avg. Drilling Time*	*Rock Type*
	From	*To*	*Interval*	*Minutes per Foot*	
Recent alluvium	0	185	185	—	No record
Wilcox gr.	185	1530	1345	—	No record
Porters Creek fm.	1530	2091	746	—	No record
	2091	2180	89	2.8	Clay
Clayton fm.	2180	2190	10	2.2	Limestone streaks
Owl Creek fm.	2190	2194	4	3.2	Shale
McNairy (Ripley) fm.	2194	2221	27	0.6	Sand
	2221	2393	172	—	No record
	2393	2395	2	20.0	Limestone
	2395	2630	235	—	No record
	2630	2665	35	3.0	Shale
	2665	2703	38	—	No record
	2703	2712	9	4.9	Shale
Bonneterre fm.	2712	2731	19	15.5	Shale, limy
	2731	3345	614	—	No record

Sample log of the City of Steele, Exploratory hole. Location: SE NW NE sec. 26, T. 17 N., R. 11 E., Pemiscot County, Missouri. Elevation: 260 feet. Completed in March of 1947 by Layne-Arkansas Company of Stuttgart, Arkansas. Well No. 7 on map, Pl. 1. Mo. G. S. No. 9460.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
No samples	18	100
Sand, rounded to sub-rounded, some silt	162	180
Clay, gray, silt	60	240
Gravel	35	265
No samples	10	275
Tertiary system:		
Eocene series:		
Wilcox group:		
No samples	35	310
Sand, polished grains, medium	20	330
Clay, brown	45	375
Sand, angular to sub-rounded	20	395
Clay, gray	25	420
Sand, sub-rounded, polished grains some silt	100	520
Sand, as above, coarse	380	900
Sand and shale	60	960
Shale	35	995
Sand and silt	120	1115
Clay, brown, gray and green	95	1210
Sand, coarse	245	1455
Sand and silt	143	1598
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, gray, micaceous, silt	217	1815
Clay, gray, micaceous	185	2000
Clay, gray, micaceous, glauconitic, fossiliferous	96	2096
Clayton formation:		
Limestone, white, glauconitic	14	2110
Cretaceous system:		
Owl Creek formation?:		
Sand, angular, glauconitic	20	2130
Clay, brown, glauconitic, sand angular, pyrite	70	2200
McNairy (Ripley) formation:		
Sand, interbedded with clay, glauconitic	137	2337

NOTE: Drilling time was recorded from 1515 to 2337 feet. An electrical survey was made by Halliburton Company from 188 to 2336 feet. Sixteen inch casing was set from the surface to 190 feet. The City of Steele has a well 321 feet in depth which was bottomed in the Wilcox sand, and which yields 350 gallons per minute. The water level is 8 feet below ground level when the pump is idle.

Log of the Horton Lumber Company well. Location: NW sec. 33, T. 22 N., R. 4 E., Ripley County, Missouri. Elevation: 285 feet. Drilled in 1894? Well No. 1 on map, Pl. 1.

NOTE: No accurate log was kept on this well, but the following information is available:

About 5 miles southwest of Naylor an oil prospect was drilled to a depth of 990 feet in 1888 by the Horton Lumber Company. No log was preserved and the reports available are somewhat conflicting. From unpublished Survey notes made in 1895 by C. F. Marbut, a well about 5 miles west of Neelyville, undoubtedly the well under discussion, was mentioned as follows: "The drill passed through a little sand at the top and a thin layer at 25 feet from the surface. Below this to a depth of 700 feet the drill passed through clays of various colors. At 700 feet the Paleozoic

limestone floor was struck." Others reported that the only solid rock encountered on all the drilling was a layer of sandstone 12 feet thick struck at a depth of 750 feet. As the well was located only about 3 miles from the Paleozoic escarpment (representing the old shore line) a depth of 700 feet to bed rock seemed remarkable and a depth of 990 feet almost inconceivable but such might be the case. "An abundance of water was encountered all the way down and all efforts to case it off proved futile. When it was abandoned water stood at the surface." (Shepard, 1907, p. 178).

The following is reprinted from the December 1, 1932 issue of the Doniphan Prospect-News and was originally published by that paper in December, 1894.

"A fairly strong flow of gas has been struck in the wildcat well being drilled by Mr. Horton at the end of the tramway track of the Horton Land and Lumber Company located about 15 miles southeast of this City (Doniphan). The gas comes through 2 or 300 feet of water, the hole being somewhere in the neighborhood of 600 feet deep. This gas has the mephitic smell of gas produced in the Ohio and Indiana fields. The rock is the Trenton limestone, the same formation in which is found the big oil and gas deposits of these fields."

This great thickness of unconsolidated sediments very near the Ozark escarpment is uncommon. There is a good possibility that much of the so-called clay consist of red muds and completely leached dolomite of the Roubidoux and Gasconade formations. The geology of the area does not permit the presence of Trenton limestone and the rock is probably Canadian or Ozarkian dolomite.

Sample log of the Graysboro School, No. 1 well. Location: SW SW NW sec. 26, T. 30 N., R. 14 E., Scott County, Missouri. Well No. 1 on map, Pl. 1. Mo. G. S. No. 7334.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, coarse, polished, arkosic, limonitic	38	38
Ordovician system:		
Kimmswick formation:		
Limestone, white, coarsely crystalline, crinoidal	62	100
Decorah formation:		
Limestone, dark, green shale	15	115

NOTE: The well was cased with 71 feet of 7-inch casing. The water level stood 40 feet below the surface, and the well was reported to yield 30 gallons per minute.

Sample log of the Missouri Institute of Aeronautics Incorporated, Harvey Parks Airport No. 1 well. Location: NW SW NW sec. 36, T. 30 N., R. 13 E., Scott County, Missouri. Elevation: 335 feet. Completed in 1943 by Weldon Well Company of Cape Girardeau, Missouri. Well No. 3 on map, Pl. 1. Mo. G. S. No. 8329.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, brown	25	25
Sand, medium to coarse, arkosic, pea gravel	100	125
Gravel	10	135
Sand, coarse, pea gravel	15	150
Ordovician system:		
Dutchtown formation:		
Limestone, dark gray-black. Insoluble residue about 50 percent, gray porous shale	75	225

Sample log of the Missouri Institute of Aeronautics Incorporated, Harvey Parks Airport No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
St. Peter-Everton formation:		
Sandstone, rounded and frosted grains, some well cemented	15	240
Sandstone, quartzite	20	260
Sandstone, quartzite, stalactitic limonite Crevice?	15	275
Sandstone, as above, some dolomite	20	295
Dolomite, very sandy, some pale green shale	45	340

NOTE: A second well was drilled 300 feet due east of well No. 1 to a depth of 260 feet. Well No. 2 was cased to 114 feet with 10-inch casing, to 160 feet with 8-inch casing, and to 185 feet with 6⅝-inch casing. Well No. 2 produced 75 gallons per minute with 2½ feet of drawdown from a static water level of 16 feet. Well No. 1 was constructed similar to well No. 2 and had a similar production. The yield from these wells was above the average for the St. Peter-Everton sandstone for this area. Apparently the sandstone was fractured and creviced which accounted for the high yield.

Sample log of the City of Fornfelt, No. 1 well. Location: NE NW NE sec. 5, T. 29 N., R. 14 E., Scott County, Missouri. Elevation: 366 feet. Completed in April 1937 by E. M. Gould of Cape Girardeau, Missouri. Well No. 4 on map, Pl. 1. Mo. G. S. No. 4196.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
No samples, driller reports blue clay	53	53
Ordovician system:		
Joachim formation:		
Dolomite, brown to cream, finely crystalline to granular. Insoluble residue, 5 to 15 percent, fine sand, gray-brown shale	187	240
Dutchtown formation:		
Limestone, dark gray to black, dense, ostracods. Insoluble residue 10 to 50 percent, shale gray to tan porous, with fossil prints	130	370
St. Peter-Everton formation:		
Sandstone, medium-grained, fairly well cemented	60	430
Everton formation:		
Limestone, dense, sandy	3	433

NOTE: The well was cased from the surface to 60 feet 8 inches with 14-inch casing and to 228 feet 5 inches with 10-inch casing. The water level stood at 3 feet below the surface. The well produced 150 gallons per minute with 140 feet of drawdown. No doubt much of the yield was obtained in crevices above the sandstone which the driller reported at 204 to 206 feet, 230 to 251 feet, and 351 to 367 feet. The water level at 247 feet rose from 20 feet below the surface to 3 feet below the surface. No change in water level occurred in the sandstone.

***Log of the V. J. Bugg, No. 1 well. Location: SW NW NW sec. 6, T. 29 N., R. 14 E., Scott County, Missouri. Elevation: 342 feet. Completed in 1921. Well No. 5 on map, Pl. 1. Mo. G. S. No. 2083.**

NOTE: No log is available, but 18 samples below 400 feet were from the Everton dolomite. The well site was about 70 feet above the top of the St. Peter sandstone in the Dutchtown limestone.

Sample log of the City of Illmo, No. 1 well. Location: SE SE NW sec. 3, T. 29 N., R. 14 E., Scott County, Missouri. Elevation: 400 feet. Completed in June 1933 by E. M. Gould of Cape Girardeau, Missouri. Well No. 6 on map, Pl. 1. Mo. G. S. No. 2722A.

	Thickness, Feet	*Depth, Feet*
No samples	25	25
Ordivician system:		
Plattin formation:		
Limestone, dark gray, dense. Insoluble residue 5 to 10 percent, chert, smooth gray, dolomoldic	80	105
Limestone, as above. Insoluble residue 5 percent, gray shale	110	215
Limestone, as above, oolitic and conglomeratic	10	225
Rock Levee formation:		
Limestone, dark gray, dense. Insoluble residue 5 percent, gray porous shale. Much surface sand from 235 to 300 feet	240	465
Joachim formation:		
Dolomite, buff to cream, finely crystalline to granular. Insoluble residue 5 to 10 percent, gray and brown shale, very fine sand, some smooth gray chert at 500 feet	235	700
Dutchtown formation:		
Limestone, gray to black, dense, fossiliferous. Insoluble residue 5 to 50 percent, gray to brown porous shale	150	850
St. Peter-Everton formation:		
Sandstone, medium to fine-grained	65	915
Everton formation:		
Dolomite, sandy	7	922

NOTE: Considerable difficulty was experienced during the drilling of this well caused by mud-filled crevices. The well was finally cased from the surface to 320 feet with 10-inch casing. At that depth 205 feet of 6¼-inch casing was swedged to the 10-inch casing. The bottom of the 6¼-inch casing was set in a wall packer at 525 feet. The production of the sandstone was low, and the sandstone was shot with 100 quarts of gelatin in the interval 882 to 916 feet. The water level stood 68 feet below ground level, and the well produced 40 gallons per minute as contrasted to the Fornfelt well which produced 150 gallons per minute. In the Fornfelt well some of the crevices above the sandstone furnished the additional water.

Sample log of the Father J. Keusenkothen, No. 1 well. Location: At Kelso, SW NW SE sec. 7, T. 29 N., R. 14 E., Scott County, Missouri. Elevation: 430 feet. Completed in October 1938 by E. M. Gould of Cape Girardeau, Missouri. Well No. 7 on map, Pl. 1. Mo. G. S. No. 5140.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Clay, yellow	45	45
Ordovician system:		
Joachim formation:		
Dolomite, buff, finely granular. Insoluble residue 5 to 10 percent, very fine sand	80	125
Dolomite, as above. Insoluble residue, 40 percent, sand, medium, rounded and frosted, grains	5	130
Dolomite, as above. Insoluble residue 5 to 10 percent, fine sand and tan shale	75	205
Dutchtown formation:		
Limestone, dark gray, dense	10	215
Dolomite, dark gray, dense, shaly	15	230
Limestone, gray to black, dense. Insoluble residue 5 to 50 percent, dark brown and gray shale	95	325

Sample log of the Father J. Keusenkothen, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Dolomite, dark gray. Insoluble residue 5 to 50 percent, gray shale	30	355
St. Peter-Everton formation:		
Sandstone, white	10	365

NOTE: The well was cased at 60 feet with 8-inch casing. The water stood 70 feet below the surface.

Sample log of the L. W. Heisserer, No. 1 well. Location: NE NE NE sec. 8, T. 29 N., R. 14 E., Scott County, Missouri. Elevation: 375 feet. Completed in October 1943 by Schneider and Gwin of Cape Girardeau, Missouri. Well No. 8 on map, Pl. 1. Mo. G. S. No. 8450.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium?:		
Clay, yellow	20	20
Clay, gray	40	60
Clay, brown, polished sand	20	80
Ordovician system:		
Plattin formation:		
Dolomite, black chert, polished sand	25	105
Dolomite	15	120
Limestone, gray dense	35	155
Joachim formation:		
Dolomite, buff, finely granular. Insoluble residue 5 to 10 percent, fine sand, brown and gray shale	180	335

NOTE: The well was cased with 85 feet of 7-inch casing. The water level was 25 feet below the surface, and the well yielded 7 gallons per minute. The driller reported water at 135, 210, and 305 feet.

Sample log of the City of Chaffee, No. 2 well. Location: NE SW NE sec. 18 T. 29 N., R. 13 E., Scott County, Missouri. Elevation: 342 feet. Completed in 1930 by F. M. Luth of St. Louis, Missouri. Well No. 9 on map, Pl. 1. Mo. G. S. No. 2147.

NOTE: No formational summary is given for this well due to difficulty in correlating the 269 samples that were saved. Many geologists have examined the samples, but no agreement has been reached among them, there being almost as many correlations as there has been geologists examining the samples. Some geologists indicated duplication of section and ascribed it to faulting, others believed that all the formations were developed in much greater thickness than is normal, and the writer believes that the samples were mixed during the drilling.

In any event it appears that the alluvium was drilled to a depth of 96 feet where the well penetrated the Everton dolomite. The Powell, Cotter, and Jefferson City formations appeared to be present in unusual thickness. The Roubidoux section seemed too low in sand content. The writer believes that the lowermost 50 feet represented the Gunter member and possibly the uppermost portion of the Eminence formation.

The well was completed at depth 2075 feet. The water level was 12 feet below the surface, and the well produced 120 gallons per minute with a drawdown of 8 feet.

Sample log of the Herman Blattel, No. 1 well. Location: NW SW NW sec. 16, T. 29 N., R 14 E., Scott County, Missouri. Elevation: 430 feet. Completed in May 1941 by Schneider & Gwin of Cape Girardeau, Missouri. Well No. 10 on map, Pl. 1. Mo. G. S. No. 7202.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Silt, yellow	20	20

Sample log of the Herman Blattel, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, brown, coarse to fine	30	50
Sand, as above, black chert	15	65
Ordovician system:		
Joachim formation:		
Dolomite, cream, dense, sandy	110	175
Dutchtown formation:		
Limestone, blue-gray, shaly	140	315
St. Peter-Everton formation:		
Sandstone, white, medium to coarse	3	318

NOTE: The well was cased at 88 feet with 6¼-inch casing. The water level was 90 feet below the surface, and the well produced 30 gallons per minute with no drawdown.

Sample log of the Anton Blattel, No. 1 well. Location: SW NE SE sec. 24, T. 29 N., R. 13 E., Scott County, Missouri. Elevation: 505 feet. Completed in May 1941 by Schneider & Gwin of Cape Girardeau, Missouri. Well No. 11 on map, Pl. 1. Mo. G. S. No. 6850.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Clay or silt, tan	35	35
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, medium-fine, some chert in upper and lower portions	138	173

NOTE: The well was cased at 169 feet with 6¼-inch casing. The water level was 140 feet below the surface, and the well produced 10 gallons per minute with 5 feet of drawdown.

Sample log of the Albion Anderson, No. 1 well. Location: C. SW¼ sec. 19, T. 29 N., R. 15 E., Scott County, Missouri. Elevation: 350 feet. Completed in April 1943 by Schneider & Gwin of Cape Girardeau, Missouri. Well No. 12 on map, Pl. 1. Mo. G. S. No. 8317.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Silt, yellow	10	10
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, fine, angular	40	50
Clay, yellow, white	35	85
Clay, yellow, blue chert (reworked)	20	105

NOTE: The well had 79 feet of 7-inch casing, and 39 feet of 5-inch casing (perforated?) was set at 105 feet. Water level was 20 feet below the surface, and the well yielded 60 gallons per minute with no drawdown.

Sample log of the Weldon Slinkard, No. 1 well. Location: C. SW SW sec. 26, T. 29 N., R. 14 E., Scott County, Missouri. Elevation: 400 feet. Completed in June 1942 by Schneider & Gwin of Cape Girardeau, Missouri. Well No. 13 on map, Pl. 1. Mo. G. S. No. 7852.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium?		
Silt, pea gravel, sand	45	45
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, medium to coarse	45	90
Sand, as above, chert	10	100
Chert, gray and black (reworked)	5	105
Sand, as above, some chert	5	110

NOTE: The well was cased with 110 feet of 7-inch (perforated?) casing. The water level was 70 feet below the surface.

Sample log of the H. V. Ashley, No. 1 well. Location: NE NE NW sec. 28, T. 29 N., R. 14 E., Scott County, Missouri. Elevation: 440 feet. Completed in January 1944 by Schneider Drilling Company of Cape Girardeau, Missouri. Well No. 14 on map, Pl. 1. Mo. G. S. No. 8594.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Silt, brown	25	25
Tertiary system:		
Pliocene? series:		
Gravel	15	40
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, fine to coarse	55	95
Ordovician system:		
Everton formation:		
Dolomite, very sandy	140	235

NOTE: The well was cased at 143 feet with 7-inch pipe and at 235 feet with 5½-inch (perforated?) pipe. The water level was 115 feet below the surface, and the well produced 20 gallons per minute with 5 feet of drawdown.

Driller's log of the Catholic Church, No. 1 well. Location: New Hamburg, SW SW SW sec. 35, T. 29 N., R. 13 E., Scott County, Missouri. Elevation: 459 feet. Completed in 1914 by A. J. Patterson. Well No. 15 on map, Pl. 1.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Clay, brown	50	50
Clay, red	4	54

Driller's log of the Catholic Church, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sandstone, white, micaceous	60	114
Gravel, (probably chert)	5	119
Ordovician system:		
Everton formation:		
Limestone, (probably dolomite)	126	245

NOTE: The water level was 135 feet from the surface. The driller reported no drawdown, presumably a bailer test.

Sample log of the Oscar Deinberger, No. 1 well. Location: NE NE NE sec. 9, T. 28 N., R. 13 E., Scott County, Missouri. Elevation: 380 feet. Completed in 1941 by Schneider & Gwin of Cape Girardeau, Missouri. Well No. 16 on map, Pl. 1. Mo. G. S. No. 7407.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Silt, yellow	30	30
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, fine, angular	20	50
Clay, yellow, red, green	10	60
Ordovician system:		
Everton formation:		
Quartzite, medium-grained	10	70
Dolomite, sandy, some green shale	145	215
Dolomite, sandy, some green shale, dolomite white and brown chert, dolomoldic	125	340

Sample log of the Ray Lucas, Jim Norrid No. 1 well. Location: C. W½ W½ sec. 6, T. 28 N., R. 14 E., Scott County, Missouri. Elevation: 390 feet. Completed in 1934 by E. M. Gould of Cape Girardeau, Missouri. Well No. 17 on map, Pl. 1. Mo. G. S. No. 3119.

	Thickness, Feet	*Depth, Feet*
Undifferentiated:		
Clay, yellowish-brown, sandy	50	50
Ordovician system:		
Everton formation:		
Dolomite, slightly sandy	113	163

Sample log of the W. C. Pattongill, No. 1 well. Location: NW SE SE sec. 6, T. 28 N., R. 14 E., Scott County, Missouri. Elevation: 445 feet. Completed in 1934 by E. M. Gould of Cape Girardeau, Missouri. Well No. 18 on map, Pl. 1. Mo. G. S. No. 3137.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Silt, yellow	50	50

Sample log of the W. C. Pattongill, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, gray, medium-coarse	30	80
Sand, as above, some white clay	10	90
Sand, medium-coarse	50	140
Sand, as above, chert pebbles	5	145
Sand, as above, gray clay	5	150
Clay, gray	10	160
Ordovician system:		
Everton formation:		
Limestone, gray dense, ostracods	8	168

Sample log of the City of Oran, No. 1 well. Location: SE SE SE sec. 18, T. 28 N., R. 13 E., Scott County, Missouri. Elevation: 335 feet. Completed March 1936 by E. M. Gould of Cape Girardeau, Missouri. Well No. 19 on map, Pl. 1. Mo. G. S. No. 3561.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, yellow and brown	15	15
Sand, clay	15	30
Clay, sandy, lignitic	15	45
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, very fine	20	65
Sand, very fine, iron stained	35	100
Sand, limonitic	10	110
Sand, fine	20	130
Sand, fine, gray chert	12	142
Sand, as above, dolomite boulders	5	147
Ordovician system:		
Everton formation:		
Dolomite	2	149

NOTE: The well was cased from the surface to 122 feet with 8-inch wrought iron pipe to which was attached 25 feet of screen. A pump test indicated a yield of 5 gallons per minute. The screen was then reset from 26 to 47 feet. The well then produced 77 gallons per minute with 14½ feet of drawdown from a static water level of 22 feet. The water from the alluvium contained so much iron that it was unsatisfactory.

Driller's log of the County Court, Jail No. 1 well. Location: NE NW NW sec. 13, T. 28 N., R. 13 E., Scott County, Missouri. Elevation: 435 feet. Completed in December 1904 by Charles S. Wise of St. Louis, Missouri. Well No. 20 on map, Pl. 1. Mo. G. S. No. 200.

	Thickness, Feet	*Depth, Feet*
Clay, yellow	55	55
Gravel, hard	10	65
Iron ore, yellow boulders, soft	30	95
Quicksand	36	131
Lithographic stone, brown, medium	9	140
Quicksand and metamorphic sandstone	18	158

Driller's log of the County Court, Jail No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Limestone, gray, medium	22	180
Limestone, brown, medium; strong odors of gas	50	230
Limestone, brown-buff, medium, with sand	200	430
Sandstone, yellow, medium	8	438
Sandstone, gray, medium	9	447
Sandstone, yellow, medium coarse	28	475
Limestone, blue, medium	95	570
Trenton limestone, brown, medium; gas odor	30	600
Limestone, blue, medium	30	630
"Gypsum" (calcite?), white, soft; here 200 gallons of water per minute rose within 100 feet of top	20	650
Limestone, gray, hard	5	655
Shale, black, medium	45	700
Limestone, blue, gray, medium	135	835
Limestone, gray, hard	195	1030
Limestone, blue, gray, hard	60	1090
Limestone, gray hard	82	1172
Limestone, blue, gray, hard	8	1180
Limestone, blue, hard	20	1200
Limestone, buff, gray, hard	40	1240
Dolomite, brown, hard	80	1320
Dolomite, gray, hard	30	1350
Dolomite, buff, hard	15	1365
Dolomite, brown, hard	5	1370
Dolomite, gray, hard	50	1420
Dolomite, brown, hard, gray	20	1440
Dolomite, black, hard	60	1500

NOTE: A total of 39 widely spaced samples were available from this well. An examination of the samples indicated the base of the loess and the top of the McNairy (Ripley) sand at 55 feet. The base of the McNairy and top of the Everton dolomite were drilled at 158 feet. The well probably bottomed in the Jefferson City dolomite. The "lithographic stone" reported by the driller consisted of gray to brown finely granular dolomite and was believed to belong to the Everton formation. This dolomite was also noted in wells No. 21 and 22 Scott County on map, Pl. 1. The presence of McNairy below the Everton may be explained by a fault. The dolomite has not been found in such relationship at any other locality. Misplacement of samples was ruled out because the three wells were each drilled by different drillers.

The County Court well was cased to 160 feet with 6-inch casing. The water level was 120 feet below the surface. The driller reported that approximately 200 gallons of water per minute was found at 650 feet. No cuttings could be obtained below 1440 feet.

Sample log of the Benton Public School, No. 1 well. Location: SE NW NW sec. 18, T. 28 N., R. 14 E., Scott County, Missouri. Elevation: 440 feet. Completed in January 1937 by Farmington Drilling Company of Farmington, Missouri. Well No. 21 on map, Pl. 1. Mo. G. S. No. 4279.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Silt, tan	55	55
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, fine to medium, micaceous, chert pebbles	40	95
Sand, white, coarse	35	130

Sample log of the Benton Public School, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Ordovician system:		
Everton formation?:		
Dolomite, gray to black, finely granular	15	145
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, coarse, white	5	150
No samples below 150. Drillers log 150 to 183		
Cretaceous and Ordovician systems:		
Lime, gray, hard	15	165
Sand, yellow and brown, medium	5	170
Sand, brown	5	175
Sand, white, soft, carries lots of water	5	180
Dolomite, blue-green, hard	3	183

NOTE: The well was cased with 134 feet of 8-inch casing and 143 feet of 6-inch casing. The water level was 120 feet below the surface, and the well yielded 4½ gallons per minute by bailer test.

It will be noted that this well encountered Everton dolomite with Ripley sand above and below it. The sand from 145 to 150 might have come in due to a faulty casing seal. No samples were available below 150 feet with which to verify the driller's log.

Sample log of the Tom Scott, No. 1 well. Location: NW SW SW sec. 13, T. 28 N., R. 13 E., Scott County, Missouri. Elevation: 400 feet. Completed in August 1935 by E. M. Gould of Cape Girardeau, Missouri. Well No. 22 on map, Pl. 1. Mo. G. S. No. 3455.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Silt, tan	40	40
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, gray, micaceous, sandy		
McNairy (Ripley) formation:		
Sand, medium-to-coarse	115	155
Ordovician system:		
Everton formation:		
Dolomite, gray to black, fine-grained	15	170
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, coarse	38	208

NOTE: The well was cased at 158½ feet with 6-inch casing. The water level was 70 feet below the surface and the well yielded 10 gallons per minute with 25 feet of drawdown. In 1937 the well had filled with sand, and the yield declined. There was then set 48½ feet of 4½-inch liner to which was attached 7 feet of 4½-inch screen. It will be noted that the dolomite horizon encountered in wells No. 20 and 21 was found in this well with McNairy (Ripley) sand above and below it.

Sample log of the Charles Butler, No. 1 well. Location: SW NW SE sec. 29, T. 28 N., R. 13 E., Scott County, Missouri. Elevation: 380 feet. Completed in August 1937 by E. M. Gould of Cape Girardeau, Missouri. Log No. 23 on map, Pl. 1. Mo. G. S. No. 4425.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium?		
Silt, tan, polished sand, chert pebbles	10	10

Sample log of the Charles Butler, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Tertiary system:		
Paleocene series:		
Midway group:		
Porters Creek formation?		
Clay, light tan, micaceous	10	20
Clayton formation:		
Clay, dark gray, glauconitic	10	30
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, gray, lignitic, micaceous	15	45
Sand, very fine-grained	15	60
Clay, micaceous	25	85
Sand, fine to coarse	101	186

NOTE: The well was cased with 184 feet of 6-inch casing and 5 feet of screen. The water level was 55 feet below the surface, and the well yielded 24 gallons per minute with 15 feet of drawdown.

Driller's log of the City of Sikeston, Malone Park well. Location: SW SW SW sec. 19 (projected), T. 26 N., R. 4 E., Scott County, Missouri. Elevation: 326 feet. Completed in 1907 by Charles Wise of St. Louis, Missouri. Well No. 24 on map, Pl. 1.

NOTE: No detailed log is available, but Mr. Wise stated, "The well was drilled to 890 feet, at which depth a string of tools were lost in the hole. There was 735 feet of 8-inch casing set in solid limestone." The casing was probably set in the Paleozoic dolomite.

Sample log of the City of Sikeston, No. 3 well. Location: SW SW SE sec. 19 (projected), T. 26 N., R. 14 E., Scott County, Missouri. Elevation: 327 feet. Completed in December 1932 by Carloss Well Company of Memphis, Tennessee. Well No. 25 on map, Pl. 1. Mo. G. S. No. 2700.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, igneous pebbles	40	40
Gravel, chert, some sand	150	190
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay, gray, lignitic	27	217
Sand, medium to coarse	83	300
Sand, coarse	50	350
No samples, driller reports sand	35	385
No samples, driller reports clay	10	405
Paleocene series:		
Midway group:		
Porters Creek formation:		
No samples, driller reports clay	10	405

NOTE: The well was cased from the surface to 317 feet with 13-inch pipe. Inserted in the bottom of the latter with a lead seal was 10-inch pipe to the bottom of which was attached 66 feet of 8-inch screen. The water level was 27 feet below the surface. When the well was pumped at 918 gallons per minute, the water level fell to 62 feet below the surface.

In March 1940 the Carloss Well Company completed well No. 4 to a depth of 375 feet. This well was cased to approximately 300 feet with 10-inch pipe to which was attached 60 feet of 10-inch screen. The water level was 40 feet below the surface and when pumped at 905 gallons per minute, there was 60 feet of drawdown.

***Sample log of the Kentucky Oil and Gas Company, No. 6 well. Location: NE NE NE sec. 31, T. 28 N., R. 11 E., Stoddard County, Missouri. Elevation: 370 feet. Completed in 1924 by Peck and Duval of Kansas. Well No. 1 on map, Pl. 1. Mo. G. S. No. 3071.**

	Thickness, Feet	*Depth, Feet*
Only the driller's log is available to 505 feet.		
Soil, clay	85	85
Gravel. Set 10-inch casing	10	95
Sand, rock, some lime	25	120
Sand, lime and flint	50	170
Clay, sand, iron	30	200
Lime	40	240
Lime, shale	20	260
Soapstone	5	265
Shale and red clay (some gas)	10	275
Brown shale	10	285
Dark shale. Set 8-inch casing	10	295
Lime, shale, flint	10	305
Lime, dark sand (some oil)	15	320
Lime, shale black	15	335
No record	170	505
Samples were received from 505 to 740 feet.		
Dolomite, about 10 percent chert, chert is brown dolomoldic, quartzose, and translucent, some green shale and sand	235	740
The following correlation is suggested:		
Quaternary system:		
Pleistocene series:		
Recent alluvium:	95	95
Canadian system:		
Powell, Cotter and Jefferson City formations:	410	505
Jefferson City formation:	235	740

NOTE: The above company drilled at least 3 wells in this vicinity, the deepest of which was 985 feet.

***Sample log of the G. E. Kinder et al, Rehms No. 1 well. Location: SE NE sec. 32, T. 28 N., R. 11 E., Stoddard County, Missouri. Elevation: approximately 400 feet. Completed in May 1944 by Lattie Goggins of Elvins, Missouri. Well No. 2 on map, Pl. 1. Mo. G. S. No. 9205.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, yellow	47	47
Clay, red	10	57
Clay, green	8	65
Pebbles, chert, brown	20	85
Canadian system:		
Powell formation:		
Dolomite, somewhat cherty and silty, some very fine sand, quartz druse, green shale at base	155	240
Cotter and Jefferson City formations:		
Dolomite, with white dolomoldic chert, smooth gray-brown chert, chert content about 15 percent, a little sand	145	385
Dolomite, smooth gray chert, silicified brown oolites, gray tripolitic chert	395	780
Roubidoux formation:		
Dolomite, with smooth gray and tan quartzose chert, some sand in upper 35 feet	155	935

Sample log of the Missouri Power and Development Company, No. 1 well. Location: At Puxico, SW SW SE sec. 26, T. 27 N., R. 8 E., Stoddard County, Missouri. Completed in August 1929. Well No. 3 on map, Pl. 1. Mo. G. S. No. 2251.

	Thickness, Feet	*Depth, Feet*
No samples	10	10
Canadian system:		
Jefferson City formation:		
Dolomite, very buff from oxidized drill steel, originally white, finely crystalline with organic matter. Insoluble residue of 35 percent contains chert, gray, brownish-gray, and brown, translucent to quartzose, slightly oolitic and dolomoldic, small amount of angular quartz. One piece of dense black chert, small amount of sand. 2 samples	10	55
Dolomite, gray, fine-grained, slightly stained as above. Insoluble residue small, shows chert, brown translucent and dead white, some sand and angular quartz. 2 samples	10	65
Dolomite, grayish-brown, finely crystalline, with moderately coarse crystals of pure dolomite, Insoluble residue small with chert, white dolomoldic (heavy ribbed), some rounded oolites (?) of limonite, some chert, dense, white, some free siliceous oolites, few fine grains of sand, few fragments of shale	5	70
Dolomite, brown, similar to 65-70. Insoluble residue small with chert, brownish-gray, dense, waxy and white, dense and dolomoldic, some brown silt	5	75
Dolomite, light brown, finely crystalline. Insoluble residue small contains chert, like 70-75, some porous silt, few grains of sand	5	80
Dolomite, brown, blue-gray, finely crystalline. Insoluble residue of 35 percent contains chert, brown, gray, white, dense, waxy, to dead, slightly dolomoldic, quartzose, some white dolomoldic (siliceous) silt, 2 samples	10	90
Dolomite, brownish-gray to gray, coarsely crystalline. Insoluble residues of 10 percent at 95 feet and 100 feet, 5 percent at 105 feet, 2 percent at 110 feet, 10 percent at 115 feet, and 20 percent at 120 feet. Chert dense to very porous and drusy, gray to smoky with polished quartz sand from 95 to 110 feet. Chert, brown and live from 115 to 120 feet. Siliceous granules, very porous, white to light brown from 110 to 115 feet. Sand, very fine, angular to coarse, rounded and well frosted from 110 to 115 feet	30	120
Chert, with gray coarsely crystalline dolomite. Insoluble residue of 75 percent shows chert, gray to blue, dull to vitreous; much sandy chert and a trace of fine rounded sand	5	125
No record of cuttings	5	130
Chert, with dolomite as above. Insoluble residue of 55 percent shows chert as above and many small white to brown oolites free and in clusters; some sand as above	5	135
Chert, with gray to brown, finely crystalline dolomite. Insoluble residue of 80 percent shows chert, pyritic, gray to bluish, live with some dull, green to blackish shale	5	140
Dolomite, gray to brown, dense. Insoluble residues of 35 percent at 145 and 150 feet, show chert, white to yellowish-brown, live with some dull, shale as above, massive pyrite, and trace of fine angular sand	10	150
Dolomite, dark brown and finely crystalline, sandy from 170 to 180 feet. Insoluble residues of 25, 20, 45, and 50 percent at 5 foot intervals show chert, dark brown, live, vitreous and slightly drusy to dead white and earthy, light brown, finely dolomoldic siliceous networks	20	170

Sample log of the Missouri Power and Development Company, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Roubidoux formation:		
Sand, fine to coarse, rounded and frosted	10	180
Dolomite, dark bluish-gray and finely crystalline. Insoluble residue of 20 percent shows chert, vitreous, live, smoky blue to dark brown and some dull and dead, dense to porous with dolomolds, some sand from above	5	185
Dolomite, buff and finely crystalline. Insoluble residue of 10 percent shows chert, white, dense to porous and dolomoldic, greenish-white argillaceous material, some sand and chert from above	5	190
Dolomite, light to very dark bluish-gray and finely crystalline, in part sandy. Insoluble residues of 20, 5, 10, percent and trace at 5 foot intervals show chert, as at 185 feet from 190 to 195 feet, fragmented pyritic quartzose material from 195 to 205 feet, dolomoldic silica at 205 feet, argillaceous material and dark brown micaceous shale at 210 feet, sand and chert from above. Present in all residues	20	210
Dolomite, light bluish-gray, dense to finely crystalline, very sandy. Insoluble residue of 10 percent at 213 feet, 45 percent at 217 feet, and 10 percent at 225 feet shows chert, smoky, brown and white, live dense to dolomoldic 213 to 225 feet sand, coarse to fine, rounded and frosted from 213 to 220 feet, druse fragments and pyritic shale at 220 feet, quartzose material at 225 feet	15	225
Dolomite, brown, dense to coarsely crystalline. Insoluble residues of 20 percent at 225 feet, 15 percent at 230 feet, 20 percent at 235 feet, and 10 percent at 240 feet show chert, light brown, dense, vitreous, in part dolomoldic. 225 to 235 feet drusy and banded with brown oolites at 240 feet	15	240
Dolomite, gray and coarsely crystalline, very sandy from 245 to 255 feet. Insoluble residues of 10 percent at 245 feet, 45 percent at 250 feet, 40 percent at 255 feet and 45 percent at 260 feet shows chert, light brown, live, vitreous, very porous and dolmoldic at 245 and 260 feet, sand, as above at 250 to 255 feet	20	260
Dolomite, dark brown dense to coarsely crystalline. Insoluble residues of 10 percent at 5 foot intervals show much quartz druse, chocolate-brown chert, dense to porous, translucent to opaque and in part quartz-veined, much broken quartz and tinted jasperoidal chert; chalcedonic banding at 275 feet	25	285
Dolomite, light to dark gray, dense to coarsely crystalline. Insoluble residues of from 5 percent to 10 percent at 5 foot intervals show chert, white to light gray, porcelain-like, live, dense, and in part quartzose and veined, some porous, some with fine mammillary or concentric structure; gray pyritic porous shale; some coarse frosted sand and influx of a little very fine sand at 300 feet	25	310
Dolomite, light to dark gray, dense to medium crystalline. Insoluble residues of 10 percent each at 5 foot intervals show chert, white to buff and brown, dull to live, dense to porous in part and slightly dolomoldic, some sandy; much very coarse, rounded, and dully frosted sand; finer sand at 320 feet; white to gray argillaceous dolomoldic silica at 335 feet	25	335

Sample log of the Missouri Power and Development Company, No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Dolomite, white to light gray, dense to finely crystalline. Insoluble residues of approximately 60 percent each at 5 foot intervals show chert as described above save more iron-stained, in part sandy with red jasperoidal matrix; loosely coherent to well cemented masses of fine-grained rounded and frosted sand; some coarser sand from above	15	350
Dolomite, bluish-gray, finely crystalline and pyritic. Insoluble residues of 10 percent at 5 foot intervals show much coarse-grained, rounded and frosted sand; smoky flint; white to buff dense translucent chert; fine angular sand masses; black dense pyritic shale; pyrite; white delicately dolomoldic siliceous-argillaceous silica; round light brown to black, heavily pyritic oolites, in part containing sand grain cores	15	365
Dolomite, light gray to light brown, medium crystalline with much sand. Insoluble residues of 20 percent at 5 foot intervals show coarse-grained sand and fine angular masses as above with trace of oolites and red jasperiodal sandy chert; smoky flint at 395 feet increasing at 400 feet and in addition much gray pyritic dolomoldic chert	30	400
Dolomite, bluish-gray, dense with possibly thin sand beds to 415 feet. 30 percent insoluble material to 415 feet. Sand, coarse rounded or broken grains; large oval brown pyritic oolites, soft, pyritic, porous to partly dolomoldic grayish argillaceous material	15	415
Ozarkian system:		
Gasconade formation:		
Dolomite, bluish-gray, crystalline. Insoluble residue, 5 percent, smoky chert, gray and white chert	15	430
Dolomite, white to light gray, dense. Insoluble residue 50 percent at 435 feet, 45 percent at 440 feet shows chert, white to cream-colored, waxy dense to partly porous; in part intricately dolomoldic; some drusy with coarse quartz crystals, veined and incrusted; trace of sand from above	10	440
Dolomite, white to grayish and dense with little or no sand except at 508 feet. Insoluble residue 20 percent at 445 feet consisting of chert, grayish pyritic, dense to some porous; smoky to jasperiodal chert; medium-grained broken sand. Insoluble residues of 5 percent at 5 foot intervals to bottom consist of same material with addition of sandy shale and chert in lower part	68	508

NOTE: The well was cased at 54 feet with 10-inch casing. The water level was 40 feet below the surface. The well yielded 150 gallons per minute with a pump setting of 152 feet.

***Driller's log of the Semo Development Company, Himmelberger No. 1 well. Location: NE NE NW sec. 28, T. 27 N., R. 12 E., Stoddard County, Missouri. Elevation: 304 feet. Completed in 1928? Well No. 5 on map, Pl. 1. Mo. G. S. No. 2204.**

	Thickness, Feet	*Depth, Feet*
The following driller's record of the upper portion of the hole was submitted by J. W. Adams, manager of the company.		
Gravel, sand and river formation	138	138
Hard or flint rock	6	144
Pink fine sand	6″	144′6″
Rock, not so hard	6	150′6″
Clay and gumbo	60	210′6″
Coarse gravel	40	250′6″
Clay and gumbo	59	309′6″

Driller's log of the Semo Development Company, Himmelberger No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
The following driller's record to a total depth of 2330 feet was furnished by Mr. Foultz.		
Quicksand	315	315
10-inch casing		
Lime	40	355
Sand, artesian water	20	375
Lime	75	450
Sand	75	525
8-inch casing set		
Lime	65	590
Sand, water	20	610
Lime, green	30	640
Sand	40	680
Lime, blue	30	710
Lime, green	50	760
Sand	40	800
Lime, green	35	835
Sand, Wilcox	10	845
Lime	25	870
Sand	50	920
Lime	30	950
Sand	50	1000
Lime	80	1080
Sand	35	1115
Lime	55	1170
Sand	30	1200
Lime, black	36	1236
Sand, oil with a good showing which would undoubtedly make a good well commercially. They could not test this properly owing to the artesian water not being shut off. They went through this sand at 1340 feet into lime again	104	1340
Lime	60	1400
Sand	30	1430
Lime	50	1480
Sand	20	1500
Lime	20	1520
Sand	40	1560
Lime	30	1590
Sand	30	1620
Lime, black	30	1650
Sand 6-inch casing 1666 (set to side track lost bit)	20	1670
Lime, black	15	1685
Sand	10	1695
Lime	25	1720
Lime, sandy	20	1740
Lime, black	5	1745
Sand, oil showing	35	1780
Lime	15	1795
Lime, sandy	25	1820
Lime and sand every 10 feet	100	1920
Lime	30	1950
Sand and shale, good oil showing	15	1965
Lime, white	5	1970
Sand, pepper and salt color	5	1975
Fine white limestone	35	2010
Coarse white limestone	15	2025
Sand, brown oil (dry?)	17	2042
Sand, salt water	10	2052
Dolomite, limestone	48	2100
Sand, oil sand (dry)	20	2120
Sand mixed with black lime	5	2125

Driller's log of the Semo Development Company, Himmelberger No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Mostly lime, little sand and chert	15	2240
Black lime, set 5 3/16-inch casing	10	2250
Mostly lime, few grains sand, little chert	30	2280
Magnesium limestone, little chert and sand	30	2310
Magnesium lime with little shale, few grains sand	13	2323
Set 5 3/16-inch casing at 2323 feet		
Magnesium lime with little shale, few grains sand	7	2330
The following descriptions are the results of studies of samples.		
No samples submitted	1975	1975
Ozarkian system:		
Gasconade-Van Buren formations:		
Dolomite, buff to gray, dense and very cherty	115	2090
Dolomite, tan and dense; pyritic	60	2150
Dolomite, white and dense, pyritic	15	2165
Dolomite, white to brown, sandy and dense	20	2185
Dolomite, brown and gray, finely crystalline, and pyritic; some white porcelain-lime chert	15	2200
Dolomite, white to gray, heavily pyritic and iron-stained	15	2215
Dolomite, gray, dense and iron-stained	30	2245
No samples submitted	25	2270
Dolomite, light gray, finely crystalline stained brown from oxidized drill steel. Insoluble residue shows pyrite; white, gray, and brown chert; some rounded grains of sand; few fragments of angular quartz and a very few pieces of soft gray pyritic shale	5	2275
Dolomite, light gray finely crystalline, stained brown from oxidized drill steel. Insoluble residue contains small flat pieces of extremely fine-grained argillaceous sand and pieces of sandy shale, also chert, sand, and pyrite like above	10	2285
Dolomite, gray, stained brown from oxidized drill steel, finely crystalline, white to light brownish chert, few pieces of dark shale, some pyrite	25	2310
Gunter member?:		
Dolomite, darker gray than above, stained brown from oxidized drill steel, finely crystalline, insoluble residue contains chert like above, fragments of shale, a few grains of sand and more pyrite than above	5	2315
Dolomite, dark gray, finely crystalline with oxidized drill steel, silicified dolomite represented in insoluble residue as brown porous siliceous material with some shale, few grains of sand, chert and pyrite	8	2323
No samples submitted	267	2590
Eminence formation:		
Dolomite, light to dark brown, finely crystalline, insoluble residue large, contains chert, black, dense, waxy, with considerable porous siliceous material, much angular quartz, banded quartz and chalcedonic chert	10	2600
No samples submitted	90	2690
Dolomite, light brown, very finely crystalline, insoluble residue large with chert brown, brownish gray, waxy, translucent	10	2700
Potosi formation:		
Dolomite, gray, finely crystalline, insoluble residue shows chert, gray and light brown, waxy translucent, and dense, also quartzose and sandy, considerable angular quartz	10	2710
Dolomite, gray, brown, very finely crystalline, sandy, insoluble residue large, shows chert, dark brown, slightly oolitic, dense, waxy, with brown porous soft siliceous material, some sand, much angular quartz	10	2720
No samples submitted	80	2800

Driller's log of the Semo Development Company, Himmelberger No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Dolomite, buff with pinkish cast, and very dense	10	2810
No samples submitted	40	2850
Dolomite, gray to brown, fine-grained. Insoluble residue of 30 percent contains quartz, angular, chert, drusy with alternating bands of quartz and chalcedony, also brown, dense and waxy and gray with brown oolites	5	2855

NOTE: The water rose a few feet above the collar of the well and flowed at the rate of 8 to 20 gallons per minute. The reported oil showings in this hole could not be verified since no samples of the cuttings were available from 0 to 1975 feet.

Driller's log of the City of Bloomfield, No. 1 well. Location: NE SE NE sec. 23, T. 26 N., R. 10 E., Stoddard County, Missouri. Elevation: 458 feet. Completed in August 1925 by James Sewell of St. Louis, Missouri. Well No. 6 on map, Pl. 1. Mo. G. S. No. 2123.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Clay, reddish-brown	10	10
Tertiary system:		
Eocene series:		
Wilcox group:		
Sand, brown	30	40
Paleocene series:		
Midway group:		
Porters Creek and Clayton formations:		
Shale, blue	130	170
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Quick sand	60	230
Sand, gray, fine	40	270
Quick sand	130	400
Shale, dark blue, micaceous	10	410
Sand, coarse, good stream of water here	10	420
Shale, as above	10	430
Canadian system:		
Jefferson City formation:		
Limestone, bluish gray	20	450
Sandstone	20	470
Limestone	80	550
Sandstone, hard	30	580
Limestone	90	670
Sandstone, white, hard	110	780
Limestone	30	810
Sandstone, hard	30	840
Limestone	60	900
Sand, very fine	18	918

NOTE: The well was cased from the surface to 31 feet with 10-inch casing, from the surface to 280 feet with 8-inch casing, and from the surface to 440 feet with 6¼-inch casing. The 6¼-inch casing was later cut off at 230 feet and pulled out. The driller reported that water was found from 410 to 420 feet and from 910 to 918 feet. The water level stood 125 feet from the surface, and the well yielded 150 gallons per minute with a pump setting of 150 feet.

In December of 1943 the Weldon Well Company of Cape Girardeau, Missouri, completed well No. 2 for the city at a depth of 286 feet. Well No. 2 was located 50 feet east of well No. 1 and at the same elevation. The following formations were identified from an examination of the cuttings:

Driller's log of the City of Bloomfield, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:	15	15
Tertiary system:		
Eocene series:		
Wilcox group:	30	45
Paleocene series:		
Midway group:		
Porters Creek formation:	95	140
Clayton formation:	10	150
Cretaceous system:		
Gulf series:		
Owl Creek formation:	17	167
McNairy (Ripley) formation:	119	286

Well No. 2 was cased from the surface to 50 feet with 12-inch casing and to 266 feet with 8-inch casing. At the bottom there was attached 20 feet of 20-slot, 8-inch brass screen. The water level stood 125 feet from the surface, and the well yielded 150 gallons per minute with 24 feet of drawdown. The temperature of the water was 60 degrees Fahrenheit.

A third well was drilled to a depth of 40 feet by the Weldon Well Company for a swimming pool supply. This well was located 5 feet from well No. 2. Well No. 3 had 34 feet of 10-inch casing and 6 feet of 10-inch screen. The water stool 3 feet from the surface, and the well had a yield of 100 gallons per minute.

***Summary log from samples of the Stoddard County Exploration Co., Higgins No. 1 well. Location: C. SW SE sec. 6, T. 25 N., R. 9 E., Stoddard County, Missouri. Elevation: 348 feet. Completed July 8, 1949 by Clarke Madison of Bowling Green, Kentucky. Well No. 10a on map, Pl. 1. Mo. G. S. No. 10868.**

	Thickness, Feet	*Depth, Feet*
Quaternary sytsem:		
Pleistocene series:		
Recent alluvium? (No samples from 0 to 155 feet)	237	237
Canadian system:		
Jefferson City formation:	353	590
Roubidoux formation:	150	740
Ozarkian system:		
Gasconade-Van Buren formations undifferentiated:	445	1185
Gunter member:	35	1220
Eminence formation:	170	1390
Potosi formation:	470	1860

NOTE: No detailed description of the samples from the above well are given since the lithology of the formations below 237 feet in the above well is very similar to that of the same formations in well No. 12, Stoddard County, some 7 miles to the southeast, and descriptions of which are included in this report. The Higgins well was drilled with a hole full of water throughout most of its depth. Faint "rainbows" on the water in the slush pit were reported as "oil shows", but no oil was seen in the cuttings. An electrical log of the hole was made by the Halliburton Company before it was abandoned at 1860 feet.

***Sample log of the M. H. Marr et al, C. Barnett No. 1 well. Location: C. SW SW sec. 3, T. 25 N., R. 11 E., Stoddard County, Missouri. Elevation: 311 feet. Completed in March 1945 by Big West Drilling Company of Dallas, Texas. Well No. 11 on map, Pl. 1. Mo. G. S. No. 8742.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, medium to coarse, chert fragments, igneous particles	50	50

Sample log of the M. H. Marr et al, C. Barnett No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Tertiary system:		
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, gray to black, somewhat micaceous. Glauconitic from 190 to base (265) becoming increasingly abundant in lower portion	215	265
Clayton formation:		
Shale, green, glauconitic, sandy	6	271
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, very micaceous, black, sandy	34	305
McNairy (Ripley) formation:		
Clay, sandy, brown, micaceous	35	340
Sand, medium to fine, micaceous	115	455
Clay, sandy, micaceous	12.6	467.6
Canadian system:		
Powell formation:		
Dolomite, light gray, crystalline, residue white and gray finely porous granular silica	157.4	625
Dolomite, gray and buff, crystalline, slightly silty. Black chert at base	35	660
Cotter and Jefferson City formations undifferentiated:		
Dolomite, gray, crystalline, slightly sandy. Residue white oolitic chert and finely porous, granular silica	190	850
Dolomite, as above, pyritic. Residue contains brown siltstone and brown and gray dolomoldic chert	160	1010
Dolomite, gray, crystalline, cherty. Residue gray translucent, dead and oolitic white chert, some silt	135	1145
Roubidoux formation:		
Dolomite, gray, crystalline, sandy chert residue	15	1160
Dolomite, gray, crystalline, cherty, interbedded with sandstone	40	1200
Dolomite, gray, crystalline, cherty, somewhat sandy	140	1340
Dolomite, gray, crystalline, interbedded with layers of angular, poorly sorted sand	115	1455
Ozarkian system:		
Gasconade-Van Buren formations undifferentiated:		
Dolomite, light gray, crystalline, slightly cherty. Residue contains some sand with a small amount of blue translucent and dolomoldic chert. Some pyrite	135	1590
Dolomite, gray, crystalline, very cherty, residue contains blue smooth and translucent and dolomoldic chert. Some pyrite	64	1654
Core. Dolomite, gray crystalline and cherty	6	1660
Dolomite, gray, crystalline, cherty, residue is buff and blue smooth and dolomoldic chert. Much quartzose chert	300	1960
Gunter member:		
Dolomite, gray crystalline, some chert, dolomite interbedded with beds of poorly sorted subangular rounded and frosted sand	65	2025
Eminence formation:		
Dolomite, gray, crystalline, slightly cherty. Chert is smooth and translucent gray	75	2100
Dolomite, gray crystalline, some green shale and blue mottled chert. Pyrite	160	2260
Dolomite, gray, crystalline, very cherty and vuggy. Vugs lined with quartz druse. Chert is gray and brown quartzose	90	2350
Potosi formation:		
Dolomite, buff to gray, crystalline, slightly cherty, contains various sized vugs lined with banded quartz druse. Chert is finely porous buff to gray. Some dolomoldic and oolitic	315	2665
Dolomite, as above, some pink and red crystalline	85	2750

Sample log of the M. H. Marr et al, C. Barnett No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Cambrian system:		
Elvins group:		
Derby Doerun—Davis formations:		
Dolomite, gray to red, crystalline, pyrite. Limonite pseudomorphic after pyrite, some fine sand, quartz druse	80	2830
Dolomite, gray crystalline, slightly cherty, pyritic, small amount green shale. Residue primarily brown to gray siltstone	205	3035
Note: First appearance of glauconite in siltstone 3035 could mark top of Davis formation.		
Dolomite, gray, crystalline to dense. Residue small and principally siltstone with small amount of green shale and some fine sand aggregates	145	3180
Dolomite, as above, some red crystals. Larger percentage of residue, consisting of siltstone, fine sand and small amount of green shale	120	3300
Bonneterre formation:		
Dolomite, gray, crystalline, small residue consisting of brown, finely porous siltstone, abundant silicified cystids? occurring at 3330	48	3348
Core		
Dolomite, gray, crystalline, dense	17	3365
Dolomite, gray, crystalline, much pyrites, small residue consisting of brown porous granular silica and siltstone	85	3450
Dolomite, red and gray, crystalline, residue small, brown porous shale. Tiny specks of glauconite in silt	50	3500
Dolomite, as above, small residue, with gray, green, brown, and black shale. Little pink dolomite at 3630	200	3700
Dolomite, brownish-gray, crystalline, residue larger and consisting of brown and gray porous shale, very pyritic	95	3795
Dolomite, light brown to pink, crystalline, small siltstone residue, which is glauconitic	45	3840
Dolomite, as above, larger silt residue, slightly calcareous ..	20	3860
Dolomite, pink to gray, crystalline, very small siltstone and green shale residue, glauconitic. Fine sand in aggregates	230	4090
Limestone, pink and gray, crystalline, glauconitic, pyritic, siltstone residue	235	4325
Limestone, light gray, very glauconitic and pyritic, glauconite in large pellets. Small siltstone and green shale residue	100	4425
Limestone, pink and gray, crystalline, glauconitic, small fine sand and green shale residue	65	4490
Limestone, oolitic, pink and gray, glauconitic	50	4540
Limestone, pink and gray, crystalline, dolomitic, small fine sand residue	31.75	4571.75
Lamotte formation:		
Quartzite, gray, vitreous, hard	8.25	4580

NOTE: The last 14 inches was core hole. There was 1½ inch recovery. Drilling time is available for the entire depth from 92 feet. An electrical survey was made from 545 to 4521 feet. One hundred and sixty-two bits were used, mostly Hughes and Reed. Drilling through quartzite averaged 1 bit per foot. The hole had 92 feet of 13½-inch conductor pipe and 545 feet of 9⅝-inch surface pipe which was grouted by the Halliburton Oil Well Cementing Company.

Fossils found in the interval from 4200 to 4520 feet were submitted to Christina Lochman of the Department of Geology and Geography, Mount Holyoke College, South Hadley, Massachusetts. The following letter from Miss Lochman confirmed identification of the Bonneterre dolomite previously made by examination of insoluble residues of the cuttings:

July 14, 1945

Dear Mr. Grohskopf:

I have returned to South Hadley and have looked over the specimens which you sent. Yes, the material is from the Bonneterre formation and apparently from the same fossil horizon which I described (Jour. of Paleo. vol. 14, pp. 1-52, 1936) within the lower 20 to 50 feet of the formation, the upper limit being apparently determined by the amount of dolomitization. The few fossils which I could determine and the lithology were both characteristic of the zone. I have placed in the separate box the capsules which contain the only significant specimens of the collection and the other capsules below. I am also listing below the determination of the contents of each capsule which I examined.

Significant Specimens—

Depth

4235—cf. *Genevievella* but very poor and could be *Avonina* also
4225—small head of *Holcacephalus* (Lochman's *Norwoodina*), marked by red, other fragments—good
4215—cf. *Cedarina*—left pleural lobe of pygidium—good
4230—genal spine and end of limb of either *Holcacephalus* or *Norwoodina*—good
4430—small pearly piece is *Kinsabia varigata,* also brach frag.

Other capsules—

4520—worn pellets of organic material (similar to modern coral sand) a common facies in the Bonneterre fossil zone
4435—piece of trilobite spine
4255—residue—unidentifiable except for one possible trilobite spine
4485—unidentifiable fragment
4220—unidentifiable fragment
4210—trilobite fragments—not identifiable
4245—trilobite frag. not identifiable—piece of thoracic segment
4270—brachiopod frag., cf. *Dicellomus*
4215—nothing
4350—1 brach. cf. *Obulus,* several unidentifiable trilobiate fragments
4280—trilobite genal spine—unidentifiable
4250—some impressions, but may not even be fossils
4230—1 brach and several trilobite fragments, all unidentifiable
4480—brach frag., cf. *Dicellomus*
4250—brach frag., cf. *Lingulella*
4365—unidentifiable fragment
4230—brach frag., cf. *Lingulella*

Very sincerely yours,
(signed)
Christina Lochman

Drilling Time Record of M. H. Marr et al., Barnett No. 1 well

Formation	*Depth in Feet*			*Avg. Drilling Time*	*Rock Type*
	From	*To*	*Interval*	*Minutes per Foot*	
Recent alluvium	0	50	50	—	No record
Porters Creek fm.	50	92	42	—	No record
	92	142	50	3.8	Clay
	142	265	123	0.7	Clay
Clayton, Owl Creek, and McNairy (Ripley) fms.	265	467	202	0.2	Clay and sand
Powell fm.	467	660	192	19.5	Dolomite
Cotter-Jeff. City fms.	660	732	72	10.6	Dolomite
	732	1010	278	32.9	Dolomite
	1010	1145	135	58.1	Dolomite
Roubidoux fm.	1145	1157	12	58.7	Dolomite
	1157	1317	160	25.2	Dolomite and chert
	1317	1455	138	45.8	Dolomite and sandstone
Gasconade-	1455	1640	185	40.6	Dolomite
Van Buren fms.	1640	1665	25	93.0	Dolomite
	1665	1960	295	46.9	Dolomite
Gunter mem.	1960	2025	65	41.7	Dolomite

Drilling Time Record of M. H. Marr et al., Barnett No. 1 well—Continued.

Formation	*Depth in Feet* From	To	*Interval*	*Avg. Drilling Time Minutes per Foot*	*Rock Type*
Eminence fm.	2025	2135	110	45.8	Dolomite
	2135	2350	215	66.1	Dolomite and chert
Potosi fm.	2350	2464	114	73.2	Dolomite
	2464	2750	286	53.4	Dolomite
Elvins fm.	2750	3050	300	48.6	Dolomite
	3050	3098	48	73.5	Dolomite
	3098	3300	202	46.4	Dolomite
Bonneterre fm.	3300	4160	860	44.0	Dolomite
	4160	4571	411	21.0	Limestone
Lamotte fm.	4571	4579	8	279.4	Quartzite

***Sample log of the Dexter Oil and Gas Company, Sam Garner No. 1 well. Location: SE SE SE sec. 7, T. 25 N., R. 10 E., Stoddard County, Missouri. Elevation: 432 feet. Completed in 1915 by Fred Alten of Bridgeport, Illinois. Well No. 12 on map, Pl. 1. Mo. G. S. No. 1675.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess	35	35
Tertiary system:		
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, black	115	150
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, fine to coarse	395	545
Canadian system:		
Jefferson City formation:		
Dolomite, and sandstone, former, gray, crystalline and cherty, sandstone very fine-grained, rounded, and comprises nearly one-third of the samples	45	590
No cuttings	80	670
Dolomite, gray, crystalline	40	710
Dolomite, hard, gray, some chert and fine-grained quartzite	50	760
Roubdioux formation:		
Sandstone, fine-grained	10	770
Dolomite, dark gray, hard	30	800
Dolomite, cherty, semi-crystalline, much pyrite in sample	40	840
Sandstone, very fine-grained, some dolomite	20	860
Dolomite and sandstone, dolomite, gray crystalline, sandstone very fine-grained	20	880
Dolomite, gray crystalline, some sand	30	910
Sandstone and dolomite, former very fine-grained	10	920
Dolomite, gray crystalline, some sand	30	950
Dolomite and fine-grained sandstone	20	970
Dolomite, some sand	10	980
Sandstone, fine-grained	20	1000
Ozarkian system:		
Gasconade and Van Buren formations:		
Dolomite	10	1010
Dolomite, hard gray, some fine sand	60	1070
Dolomite, gray crystalline, much pyrite	20	1090
Dolomite, gray crystalline, a few quartz grains	20	1110
Dolomite, gray crystalline, blue chert	20	1130
Dolomite, gray crystalline, some quartz grains	20	1150
Dolomite, gray crystalline, oolitic chert	10	1160

Sample log of the Dexter Oil and Gas Company, Sam Garner No. 1 well— Continued.

	Thickness, Feet	*Depth, Feet*
Dolomite, gray crystalline, white chert, SiO_2 grains white, few rhombohedrons of dolomite, mostly dolomite	90	1250
Dolomite, gray crystalline, blue chert	70	1320
Dolomite, reddish-brown, cherty	10	1330
Dolomite, gray, fine-grained	10	1340
Dolomite, yellowish-gray, little chert	10	1350
Dolomite, gray, blue chert	10	1360
Dolomite, light gray, fine-grained, dolomite, gray, light yellow, gray	80	1440
Dolomite, gray, crystalline, cherty, white, brownish-yellow with chert, bluish-gray, light gray, blue, very fine cuttings	190	1610
Gunter member:		
Dolomite, gray, crystalline, sandy, smooth white chert and green shale	70	1680
Eminence formation:		
Dolomite, light yellowish-gray, light yellow, brownish-gray, crystalline, dark gray, free from chert, crystalline grayish-brown, calcite, few quartz particles	170	1850
No cuttings	10	1860
Potosi formation:		
Dolomite, dark gray, crystalline, few quartz particles, free from chert	10	1870
Dolomite, dark gray, crystalline, free from quartz particles, free from chert	20	1890
Dolomite, finely crystalline, gray, lighter in color than above, a very few rounded sand grains and broken quartz particles, no chert	10	1900
Dolomite, gray to dark gray, hard finely crystalline, quartz particles, clear quartz particles, light gray, large amount of rounded sand grains	40	1940
Dolomite, grayish-brown, siliceous dolomitized calcite crystals, finely crystalline, quartz grains, dark gray quartz, white chert	60	2020
Dolomite, grayish-brown, finely crystalline	10	2030
Dolomite, gray, much crystalline quartz, chert, finely crystalline, some white chert, crystalline quartz particles	10	2100
Dolomite, gray and brown, crystalline quartz	130	2230
Dolomite, as above, less quartz	100	2330

NOTE: The driller reported that much water was found in the sands between 185 feet and the solid rock. A strong flow was encountered at 560 feet, shortly after solid rock was encountered, and the water level rose to within 80 feet of the surface, where it stood upon completion of the hole. When last tested, the water was reported to be strongly sulpho-saline.

***Sample log of the M. H. Marr, W. J. Crutcher No. 1 well. Location: SW SW SW sec. 10, T. 25 N., R. 11 E., Stoddard County, Missouri. Elevation: 300 feet. Completed in June 1944 by National Geophysics Company. Well No. 13 on map, Pl. 1. Mo. G. S. No. 8573.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, gray	8	8
Sand, loose	22	30
Sand, pea gravel	34	64
Tertiary system:		
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, blue to black, hard	238	302
Clayton formation:		
Sand, glauconitic	9	311

Sample log of the M. H. Marr, W. J. Crutcher No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, brownish-black	5	316
McNairy (Ripley) formation:		
Sand, fine, loose	24	340
Clay, gray	5	345
Sand	38	383
Clay, gray	17	400
Sand	114	514
Canadian system:		
Dolomite, hard, sandy	8	522

NOTE: The hole was cored from 514 to 522 feet, 6 feet of recovery. An electrical survey was made of the hole from the surface to the total depth.

***Sample log of the U. S. Bureau of Mines, B. Zarecore No. 1 well. Location: NW NW NW sec. 18, T. 25 N., R. 12 E., Stoddard County, Missouri. Elevation: 297 feet. Completed in June 1944 by National Geophysics Company. Well No. 14 on map, Pl. 1. Mo. G. S. No. 8569.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, clay	4	4
Sand, reddish-brown, pea gravel	26	30
Sand, loose, gravel, lignite	30	60
Clay, gray, silty	49	109
Tertiary system:		
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, blue-black, hard	261	370
Clayton formation:		
Clay, green, glauconitic, sandy	4	374
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, brownish-black	5	379
McNairy (Ripley) formation:		
Sand, fine to medium-grained	221	600
Canadian system:		
Dolomite	1	601

NOTE: A core was taken from 132.6 to 143.6 feet with 10 feet of recovery, from 370.5 to 379.5 feet with 6 feet of recovery, and from 599.8 to 600.8 feet with no recovery.

Sample log of the Missouri Pacific R. R. Company, No. 1 well. Location: 1 mile west of Dexter, SW NE SE sec. 21, T. 25 N., R. 10 E., Stoddard County, Missouri. Elevation: 370 feet. Completed in summer of 1943 by Layne-Arkansas Company of Stuttgart, Arkansas. Well No. 15 on map, Pl. 1. Mo. G. S. No. 8363.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Silt or clay, yellow, fine	23	23

Sample log of the Missouri Pacific R. R. Company, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Tertiary system:		
Eocene series:		
Wilcox group:		
Sand, polished grains, some gray clay	22	45
Sand, coarse, arkosic	24	69
Sand, gray clay	21	90
Paleocene series:		
Porters Creek and Clayton formations:		
Clay, dark gray, micaceous	120	210
Clay, as above, glauconitic	15	225
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, angular to medium-fine, much glauconite, some limestone fragments	45	270
Sand, medium, angular, micaceous	65	335
Sand, fine	20	355
Sand, fine, some brown clay	25	380
Sand, fine, gray clay	90	440
Sand, white, clean, medium-grained	30	470
Sand, as above	20	490
No samples	50	540

NOTE: The well was cased from the surface to 470 feet with 10-inch casing and with 100 feet of 6-inch pipe extending 90 feet into the 10-inch casing. Attached to the 6-inch pipe was 60 feet of 6-inch screen. The water level rose to within 47 feet of the surface, and the well produced 400 gallons per minute with 34 feet of drawdown.

Sample log of the City of Dexter, No. 4 well. Location: SW NE SW sec. 23, T. 25 N., R. 10 E., Stoddard County, Missouri. Elevation: 320 feet. Completed in November 1943 by Layne-Arkansas Company of Stuttgart, Arkansas. Well No. 16 on map, Pl. 1. Mo. G. S. No. 8423.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, gray, sand	27	27
Sand, pea gravel	27	54
Tertiary system:		
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, dark gray, micaceous	196	250
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, sandy, glauconitic	20	270
Clay, gray	7	277
McNairy (Ripley) formation:		
Sand, medium, crackled grains, pyrite	68	345
Sand, gray, fine angular, some brown, glauconitic	15	360
Sand, dark gray to brown, fine, angular	42	402
Sand, white, medium, some brown	25	427
Sand, white, medium-coarse	23	450
Sand, white, coarse, pyrite	22	472
Sand, fine, more angular	46	518

NOTE: Only 24 samples representing long intervals were saved by the driller, which accounts for the absence of the Clayton formation in the log. The top and bottom of the Owl Creek are questionable.

The above is the log of a test hole drilled for well No. 4. The well was completed at a depth of 345 feet. It was cased from the surface to 279 feet 10 inches with

10-inch casing, and 65.8 feet of 6-inch casing extended 57 feet 4 inches into the 10-inch casing. Attached to the 6-inch casing was 61.8 feet of screen. The hole was undercut to 27.5 inches from 277 to 345 feet, and gravel-packed. The water level rose 5.5 feet above ground level, and the well flowed 35 gallons per minute at ground level. When pumped at 408 gallons per minute, the pumping level was 67.4 feet below the surface or a drawdown of 72.9 feet. The water had a temperature of 62 degrees Fahrenheit and a slight odor of hydrogen sulfide gas.

City well No. 1 had a depth of 289 feet and was probably completed in the upper portion of the Ripley sand. Wells No. 2 and No. 3 obtained their water from the alluvial sand.

Not far distant from the city wells is the well of the Dexter Ice and Fuel Company. This well was completed at a depth of 420 feet in the Ripley sand, the top of which was reached at 290 feet. The well flowed 25 gallons per minute at ground level and was used for cooling purposes only.

***Sample log of the U. S. Bureau of Mines, L. Thomason No. 1 well. Location: NE NE NE sec. 36, T. 25 N., R. 11 E., Stoddard County, Missouri. Completed in June 1944 by National Geophysics Company. Well No. 17 on map, Pl. 1. Mo. G. S. No. 8570.**

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Clay, brown	4	4
Sand, brown	16	20
Sand, brown, pea gravel	62	82
Sand	20	102
Sand, and pea gravel	16	118
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay, cream	4	122
Clay, some interbedded sand	21	143
Sand, fine	25	168
Clay	1	169
Sand, fine	34	203
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, blue-black, hard, some streaks of siderite	273	476
Clayton formation:		
Clay, glauconitic, calcareous	3	479
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Sand, clay streaks	20	499
McNairy (Ripley) formation:		
Sand, fine	62	561
Sand, clay streaks	20	581
Sand, fine	10	591
Sand, clay streaks	11	602
Sand	8	610

NOTE: Samples were poor. Cored from 359.9 to 370.4 feet, recovery 9.5 feet.

Sample log of the D. L. Garner, No. 1 well. Location: C. SW SW sec. 1, T. 24 N., R. 9 E., Stoddard County, Missouri. Elevation: 360 feet. Completed in May 1941 by W. Parkin and Sons of Poplar Bluff, Missouri. Well No. 18 on map, Pl. 1. Mo. G. S. No. 6975.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Loess:		
Clay, tan, fine	35	35

Sample log of the D. L. Garner, No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Tertiary system:		
Eocene series:		
Wilcox group:		
Clay, gray, sandy	20	55
Sand, coarse, black chert pebbles	25	80
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, dark gray, siderite	40	120
Clay, dark gray	60	180
Clay, dark gray, calcareous, foraminifera	20	200
Clayton formation:		
Limestone, glauconitic	10	210
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, coarse, glauconitic	14	224

NOTE: The well was cased to 218 feet with 6¼-inch oil well casing. Twelve feet of galvanized screen was set at the bottom. The water stood 30 feet below ground level and the well, when tested at 8 gallons per minute, had no drawdown. Through an error the casing was perforated at 80 feet, so that the well was producing water from 2 formations.

Sample log of the City of Bernie, No. 1 well. Location: NW SE NW sec. 3, T. 23 N., R. 10 E., Stoddard County, Missouri. Elevation: 303 feet. Completed in March 1940 by Carloss Well Company of Memphis, Tennessee. Well No. 19 on map, Pl. 1. Mo. G. S. No. 5946.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Sand, gravel, igneous particles	65	65
Sand, pea gravel, lignite	70	135
Tertiary system:		
Eocene series:		
Wilcox group:		
Sand, black chert, gray clay	120	255
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, blue-black	145	400
Clay, as above, siderite	25	425
Clay, as above, calcareous and glauconitic	115	540
Clayton formation:		
Limestone, sandy, glauconitic	10	550
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Clay, calcareous, sandy, glauconitic	40	590
McNairy (Ripley) formation:		
Sand, medium, crackled grains, glauconitic	115	685
Clay, gray, calcareous, glauconitic	5	690

NOTE: Upon completion of drilling 40 feet of 6-inch screen was set in the Ripley sand. The well flowed 125 gallons of water per minute and yielded 500 gallons per minute with a pumping level of 100 feet. Temperature of water was 71 degrees Fahrenheit. The chemical quality of the water is slightly saline. This is an unusual type of water from the Ripley in this general area; see chemical analyses table 3.

Sample log of the U. S. C.C.C. well at Sam A. Baker Park. Location: NW SW SE sec. 19, T. 30 N., R. 5 E., Wayne County, Missouri. Elevation: 620 feet. Completed in February 1935 by J. D. Judd & Son of Martin City, Missouri. Well No. 1 on map, Pl. 1. Mo. G. S. No. 3185.

	Thickness, Feet	*Depth, Feet*
Cambrian system:		
Bonneterre formation:		
Dolomite, gray, crystalline, few grains of sand and flakes of green shale which is dolomoldic	250	250
Dolomite, gray, crystalline, about half sand and brown silt or shale	100	350
Sand, arkosic	15	365
pre-Cambrian system:		
Porphyry, red	1	366

NOTE: The well produced only 2 gallons of water per minute. It was shot with 20 quarts of nitroglycerin from 350 to 366 feet, but shooting did not increase the yield. Static water level was 100 feet.

***Sample log of the A. N. Hood et al, David Evans No. 1 well. Location: C. NE sec. 15, T. 29 N., R. 5 E., Wayne County, Missouri. Elevation: 434 feet. Completed December 4, 1939 by A. N. Hood. Well No. 2 on map, Pl. 1. Mo. G. S. No. 5876.**

	Thickness, Feet	*Depth, Feet*
No samples	405	405
Cambrian system:		
Bonneterre formation:		
Dolomite, gray, crystalline with a little green shale and sand	42	447
pre-Cambrian system:		
Porphyry, red	30	477

Sample log of the U. S. C.C.C. well F-5. Location: SW SW sec. 35, T. 28 N., R. 5 E., Wayne County, Missouri. Elevation: 640 feet. Completed in October 1934 by J. D. Judd & Son of Martin City, Missouri. Well No. 3 on map, Pl. 1. Mo. G. S. No. 2996.

	Thickness, Feet	*Depth, Feet*
Ozarkian system:		
Gasconade formation:		
Chert and clay, residual	130	130
Dolomite, gray, crystalline, cherty, chert is white, dolomoldic, and oolitic	120	250
Gunter member:		
Dolomite, with interbedded sand, some green shale and dolomoldic white chert	95	345
Eminence formation:		
Dolomite, gray, crystalline, slightly cherty. Chert is gray quartzose, some free white oolites, some lacelike white dolomoldic silica	105	450

NOTE: The well was cased with 275 feet of 6-inch casing. The yield was 25 gallons per minute with 10 feet of drawdown from a static level of 190 feet.

***Driller's log of the Clay County Oil Company, No. 1 well. Location: Sec. 7?, T. 21 N., R. 5 E., Clay County, Arkansas. Elevation: approximately 300 feet. Completion date and driller unknown. Well No. A1 on map, Pl. 1.**

	Depth, Feet
Clay and sand encountered at depth of	20
Water and sand	24
Sand and gravel	155

Driller's log of the Clay County Oil Company, No. 1 well—Continued.

		Depth, Feet
E—Sand and gravel		
Blue clay		255
Limestone rock		375
Crevice in rock		873
Set 10″ casing at	1125 feet	
Set casing last time	1150 "	
Crevice of 4 feet in rock		1275
Limestone		1480
Crevice of running water in rock		1600
Total depth of well, still in limestone		1855

NOTE: The above is a very poor log. The base of the Recent alluvium is probably at 155 feet. The blue clay at 255 feet may be Porters Creek. The top of the Paleozoic is at 375 feet.

Sample log of the War Emergency Pipe Line Incorporated, No. 8 pump station well. Location: NW NW sec. 2?, T. 21 N., R. 7 E., Clay County, Arkansas. Elevation: Approximately 300 feet. Completed June 2, 1944 by Wallace Parkin & Sons of Poplar Bluff, Missouri. Well No. A2 on map, Pl. 1. Mo. G. S. No. 8752.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Silt and clay, brown	20	20
Clay, green	15	35
Sand, rounded, igneous rock fragments	15	50
Sand, pea gravel	65	115
Tertiary system:		
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, gray, micaceous	140	255
Clay, gray, micaceous, pyritic	90	345
Clayton formation:		
Marl and limestone, white, glauconitic	12	357
Cretaceous system:		
Gulf series:		
McNairy (Ripley) formation:		
Sand, white, angular, micaceous	33	390
Sand, as above some clay	10	400

NOTE: The water level in this well was 15 feet beneath the surface when the well was completed.

***Driller's log of the St. Francis Oil Company, Marshall No. 1 well. Location: sec. 28, T. 20 N., R. 9 E., Clay County, Arkansas. Elevation: 271 feet. Driller and completion date unknown. Well No. A3 on map, Pl. 1.**

	Thickness, Feet	*Depth, Feet*
Quicksand	70	70
Quicksand	25	95
Gravel	7	102
Quicksand	22	124
Gravel	16	140
Gravel	21	161
Gravel	163	324

Driller's log of the St. Francis Oil Company, Marshall No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Gumbo	20	344
(Set 10-inch casing 344 feet)		
Gumbo	19	363
Gumbo	23	386
Gumbo	12	398
Gumbo	41	439
Pack sand	22	461
Gumbo	18	479
Pack sand	32	511
Gumbo	16	527
Gumbo	21	548
Rock	2	550
Rock	1	551
Gumbo	13	574
Gumbo	8	582
Rock	1	583
Gumbo	14	597
Pack sand	8	605
Gumbo	16	621
Shale (gas)	3	624
Shale	43	667
Hard gumbo	26	693
Hard gumbo	40	733
Hard gumbo	29	762
Gumbo	24	786
Shale	18	804
Rock	2	806
Shale	18	824
Hard shale	15	839
Gumbo	11	850
Water sand	7	857
Gumbo	15	872
Shale	4	876
Gumbo	14	889
Hard gumbo	11	900
Gumbo	84	984
Pack sand	2	986
Gumbo	40	1026
Sand rock	3	1029
Hard sand rock	5	1034
Shale (gas) 10-inch casing set at 1045 feet	9	1043
Sand (more gas)	7	1050
Broken sand rock	8	1058
Pyrites	20	1078
Gumbo	36	1114
Broken sand rock	5	1119
Hard sand rock	1	1120
Rock	1	1121
Water sand	15	1236
Sand rock	2	1238
Pyrites	1½	1239½
Sand rock	3½	1243
Shale	10	1253
Gumbo	33	1286
Gumbo	34	1320
Water sand	51	1371
Hard sand rock	4	1375
Hard lime rock	2	1377
Hard blue lime rock	10	1387
Lime rock	13	1400
Lime rock	47	1447
Lime rock	13	1469
Gray sand	45	1505

Driller's log of the St. Francis Oil Company, Marshall No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Artesian water	10	1515
Gray lime flint	4	1519
Total depth of 6-inch casing 1468 feet		

NOTE: The top of the Porters Creek formation is probably at 605 feet. It is believed that the top of the Cretaceous is at 1026 feet. The top of the Paleozoic was drilled at 1375 feet, the well probably was completed in the Roubidoux formation.

Driller's log of the City of Leachville well. Location: SE NW Sec. 8, T. 15 N., R. 8 E., Mississippi County, Arkansas. Elevation: 237 feet. Completed in 1935 by Layne-Arkansas Company of Stuttgart, Arkansas. Well No. A4 on map, Pl. 1.

	Thickness, Feet	*Depth, Feet*
Top soil	5	5
Fine soil	10	15
Coarse sand	85	100
Coarse sand and gravel	75	175
Fine sand	5	180
Gumbo	36	216
Sandy shale	96	312
Chalk clay	69	381
Fine hard sand	29	410
Hard clay	33	443
Hard sand	47	490
Gumbo	29	519
Shale	10	529
Hard sand	45	574
Gumbo	15	589
Sandy shale	10	599
Hard sand and shale	31	630
Hard clean sand	63	693
Hard clay	37	730
Sand and soft clay	22	752
Hard gumbo	41	793
Sandy shale	5	798
Chalk and sandy clay	76	874
Chalk clay	37	911
Hard sand	44	955
Gumbo	10	965
Sand (hard white)	115	1080
Shale or clay	3	1083
Sand	36	1119
Hard clay	28	1147
Sandy shale	30	1177
Very fine sand	29	1206
Sandy soap stone	49	1255
Sandy shale	40	1295
Gummy shale	16	1311
Gumbo—1 ft. rock	127	1437-38
Gummy shale and boulders	4	1442
Tough gumbo	14	1456
No record	44	1500

NOTE: The following correlations are suggested for the log. Base of alluvium 180 feet, base of Wilcox and top of Porters Creek 1311 feet. The well was bottomed in the Porters Creek.

***Sample log of the Benedum-Trees Oil Company, C. W. Mack No. 1 well. Location: NW SW SW sec. 3, T. 15 N., R. 12 E., Mississippi County, Arkansas. Elevation: 267 feet. Completed March 18, 1939. Well No. A5 on map, Pl. 1. Mo. G. S. No. 5406.**
Drillers log from 0 to 1010 feet.

	Thickness, Feet	*Depth, Feet*
Quaternary system:		
Pleistocene series:		
Recent alluvium:		
Shale, black, gummy	21	21
Sand	5	26
Shale, sand streaks	54	80
Sand, gray	100	180
Tertiary system:		
Eocene series:		
Wilcox group:		
Shale, gummy	50	230
Shale, gummy, lignite	30	260
Shale, gummy	10	270
Shale, streaks of sand	20	290
Shale, blue and green, sticky	71	361
Shale, blue and gray	19	380
Shale, sandy and streaks of sand	150	530
Sand, gray, streaks of shale	55	585
Shale, green and blue, streaks of sand	205	790
Lignite, streaks of sand and shale	94	884
Lignite	23	907
Lignite and sand	26	933
Sand	47	980
Shale, gummy	30	1010
Sample log begins at 1010 feet		
Sand, brown, clay, gray	30	1040
Sand, brown, frosted grains	20	1060
Sand, as above, clay, gray, silty, kyanite	30	1090
Clay, brown, silty	50	1140
Clay, as above, sand	20	1160
Clay, brown and gray	110	1270
Clay, as above, siderite	10	1280
Clay, brown, plant remains	55	1335
Clay, as above, micaceous sand	45	1380
Sand, fractured quartz grains, kyanite	20	1400
Clay, sandy	40	1440
Sand, fractured quartz grains	160	1600
Paleocene series:		
Midway group:		
Porters Creek formation:		
Clay, dark gray	200	1800
Clay, as above, micaceous	20	1820
Clay, dark gray, foraminifera	330	2150
Clayton formation:		
Marl or limestone, glauconitic, fossiliferous	17	2167
Cretaceous system:		
Gulf series:		
Owl Creek formation:		
Shale or clay, micaceous	5	2172
McNairy (Ripley) and older formations:		
Sand, bright, angular quartz grains	28	2200
Shale, sandy	30	2230
Sand, fine grained, glauconitic	10	2240
Sand, fine grained	50	2290
Sand, fine grained calcareous cement	60	2350
Sand, glauconitic, angular, micaceous	30	2380
Sand, angular	50	2430
Sand, angular, calcareous fossils, glauconite	50	2480
Sand, angular, slightly calcareous	80	2560
Sand, angular, glauconitic, calcareous fossils	80	2640
Sand, angular, slightly calcareous	150	2790
Sand, as above, glauconitic	10	2800
Clay, dark gray, micaceous, glauconitic	6	2806

Sample log of the Benedum-Trees Oil Co., C. W. Mack No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Canadian system:		
Jefferson City formation:		
Limestone, dark gray to black, dense, oolitic.		
Residue less than 10 percent, sand, silt, sandy and oolitic chert	90	2896
As above, some dolomitic limestone	59	2955
Dolomite, gray, finely crystalline and sandy. Water encountered, level 300 feet below surface	5	2960
Limestone, dark gray, dolomitic and sandy, tan oolitic chert	10	2970
Limestone, dark gray, dense, residue 15 percent smooth tan chert some silt	30	3000
Limestone, dark gray, dense, residue less than 10 percent, smooth tan chert, a small amount of oolitic chert	42	3042
Limestone, as above, residue 60 percent, smooth tan translucent chert	5	3047
Limestone, slightly dolomitic, dark gray, dense, residue less than 10 percent, finely porous silt or shale	38	3085
Limestone, as above, sandy	15	3100
Limestone, dark gray dense, residue less than 10 percent, finely porous gray-tan shale	35	3135
Limestone, as above, residue 10 percent smooth dark gray oolitic chert	5	3140
Limestone, as above, residue less than 10 percent, gray porous shale and sand grains	10	3150
Roubidoux formation:		
Limestone, dense oolitic, residue 50 percent rounded and frosted sand grains	10	3160
Limestone, dark gray, dense, residue 5 to 50 percent, smooth gray-tan chert, oolitic	40	3200
Limestone, dolomitic, dark gray, dense, residue 5 to 25 percent, sand grains, finely porous shale, tan translucent chert	35	3235
Limestone, dark gray, (somewhat oolitic, dense, residue) less than 10 percent, sand grains, finely porous shale	50	3285
Limestone, dark gray, dense, oolitic, residue 40 percent, medium to coarse sand grains, some tan quartzose chert. Water level rose to within 100 feet of surface	25	3310
Limestone, dark gray, dense, some oolitic, residue less than 10 percent, sand grains, tan transculcent and quartzose chert, dark porous shale	50	3360
Limestone, dark gray, dense, residue 40 percent, dark translucent dolomoldic chert	7	3367
Limestone, dark gray, dense, oolitic, residue 30 percent, sand grains, some sandy chert	13	3380
Limestone, dark gray, dense, residue 20 percent, tan translucent chert, gray shale	15	3395
Limestone, dark gray, dense, some oolitic, residue averages 10 percent, angular sand, oolitic and dolomoldic tan chert	210	3605
Ozarkian system:		
Gasconade and Van Buren formations:		
Limestone, dark gray, dense, some oolitic to 4025 feet, residue 10 to 50 percent, tan chert, gray and brown porous shale or silt, oolitic chert 3570 to 3580 feet, 3650-3660 feet, 3795-3800 feet, 4000-4025 feet. *Asphaltic* residue at 3721, 4012, 4019, and 4022 feet. Strontium sulphate (celestite) common below 3850 feet	475	4075
Limestone, dark gray, dense, thin beds of dolomite limestone, residue 10 percent or less, dark gray to tan chert, brown porous shale, celestite. *Asphalt* at 4093, 4123, 4153 and 4204 feet	195	4270
Limestone, light gray to white, finely crystalline residue less than 10 percent, dark tan chert and brown porous shale, *asphalt* at 4290	48	4318

Sample log of the Benedum-Trees Oil Co., C. W. Mack No. 1 well—Continued.

	Thickness, Feet	*Depth, Feet*
Eminence formation:		
Dolomite, light and dark fine grained to crystalline, residue extremely small, a few pieces of dark shale, sand grains, white and brown quartzose chert. *Asphalt* from 4439 to 4442 feet	217	4535

NOTE: This well was drilled with rotary equipment to 2895 feet. Cable tool equipment was used from 2895 to 4535 feet. Casing was set and cemented when change was made from rotary to cable tool rig.

This set of samples is extremely interesting in that they show a change in lithology of sediments which are normally dolomite to limestone. The appearance of the limestone is similar to Plattin limestone of Missouri and Stones River of Tennessee. The presence of oolitic chert and sand, however are opposed to such correlation. It was necessary to heat the cherts in an electric muffle to eliminate the dark color to better reveal their oolitic and sandy features.

The water level in the well rose above the ground surface at 4405 feet. Upon completion of the well the flow was 70 gallons per minute of water which had a temperature of 110 degrees Fahrenheit. Samples of the water from various depths were chemically analyzed. See table 5 and figure 3.

Of interest are the various shows of asphalt noted in the samples, which were also noted by the driller as accumulations on the cable when coming out of the hole. Samples of the material are on file at the Missouri Geological Survey.

Cairo Electric Light & Power Company, No. 1 well. Location: In the city of Cairo, Alexander County, Illinois. Elevation: 313 feet. Completed in 1897. Well No. I1 on map, Pl. 1.

	Depth, Feet
Top of Porters Creek	375
Top of Cretaceous	498
Top of Paleozoic	705
Total depth	1040

NOTE: No samples available.

***Roney, Mitchell and Bruer, Bondurant No. 1 well. Location: 150 yards southeast of Bondurant Station on C.M.&Q. R.R., Fulton County, Kentucky. Elevation: 285 feet. Well No. K1 on map, Pl. Mo. G. S. No. 2666.**

	Depth, Feet
Top of Porters Creek	1340
Top of Cretaceous	1820
Top of Paleozoic	1985

NOTE: Total depth 3180? feet, completed in Gasconade formation. Samples available from 2685 to 3180 feet.

***Henderson Oil Company, Fields No. 1 well. Location: 5.5 miles S 60° W of the town of Finley, Dyer County, Tennessee. Elevation: 260 feet. Completed in 1939. Well No. T1 on map, Pl. 1. Mo. G. S. No. 6041.**

	Depth, Feet
Base of Alluvium	65
Top of Porters Creek	1680
Top of Cretaceous	2150
Top of Paleozoic	2767

NOTE: Total depth 3232 feet, completed in Bonneterre formation. Scattered samples available from 2767 to 2882 feet. An electrical log of the hole was made by the Halliburton Company.

***Henderson Oil Company, Rice (Broadmoor) No. 1 well. Location: 2.7 miles N 50° E of the town of Miston, Dyer County, Tennessee. Elevation: 260 feet. Completed in December 1939. Well No. T2 on map, Pl. 1. Mo. G. S. No. 5830.**

	Depth, Feet
Base of Alluvium	120
Top of Porters Creek	1580
Top of Cretaceous	2198
Top of Paleozoic	2550

NOTE: Total depth 2925 feet, completed in Bonneterre (?) formation. Samples available below 2170 feet. Fragmentary trilobites obtained in the interval 2620 feet to 2795 feet were identified as probably of Cambrian age by paleontologists of the U. S. Geological Survey, the same persons identified brachiopods in the same collection as *Acrotreta* sp., also an Upper Cambrian form.

***Ira T. Johnson Oil Company, S. J. Bradshaw No. 1 well. Location: 5.7 miles S 62° W of the town of Elbridge, Obion County, Tennessee. Elevation: 303 feet. Completed 1932. Well No. T3 on map, Pl. 1. Mo. G. S. No. 2717.**

	Depth, Feet
Base of Alluvium	80
Top of Porters Creek	1700
Top of Cretaceous	2105
Top of Paleozoic	2610

NOTE: Total depth 3100? feet, completed in Bonneterre formation. Samples available to 2692 feet.

***Henderson Oil Company, F. B. Carroll No. 1 well. Location: 2.1 miles N 72° W of the town of Elbridge, Obion County, Tennessee. Elevation: 465 feet. Completed in 1936. Well No. T4 on map, Pl. 1, Mo. G. S. No. 5141.**

	Depth, Feet
Top of Porters Creek	1860
Top of Cretaceous	2344
Top of Paleozoic	2690

NOTE: Total depth 3418 feet, completed in Bonneterre formation. Samples available from 2000 to 3418 feet.

***Henderson Oil Company, Linda Morris No. 1 well. Location: 1.4 miles N 32° E of the town of Ridgely, Lake County, Tennessee. Elevation: 305 feet. Completed in 1937. Well No. T5 on map, Pl. 1.**

	Depth, Feet
Top of Porters Creek	1490
Top of Cretaceous	1900
Top of Paleozoic	2560

NOTE: Total depth 2590 feet, completed in Bonneterre? formation. Driller's log available. Three other holes were drilled very near to the above well on the same farm. Well No. 2, total depth 2687? feet. Well No. 3, total depth 3260 feet, good set of samples from 2540 to 3120 feet, Mo. G. S. No. 5143. Well No. 4, total depth 2450? feet.

***Henderson Oil Company, Markham No. 1 well. Location: 3.3 miles S 50° E of the town of Tiptonville, Lake County, Tennessee. Elevation: 305 feet. Completed in 1939. Well No. T6 on map, Pl. 1. Mo. G. S. No. 6996.**

	Depth, Feet
Top of Porters Creek	1440
Top of Cretaceous	1880
Top of Paleozoic	2230

NOTE: Total depth 3990? feet, completed in Lamotte? formation. Samples available from 2238 to 3308 feet. An electrical log was made from 2400 to 3480 by the Halliburton Company.

The Paleozoic section to 3242 feet consists essentially of dark-gray, dense to medium-grained limestone, dark siliceous shales, some of which are definitely slaty, and basic igneous material.

Samples submitted by the Missouri Geological Survey to Josiah Bridge of the United States Geological Survey, yielded a definite Upper Cambrian fauna. Bridge reported as follows: (Excerpts of letter from Josiah Bridge to H. S. McQueen, January 25, 1939.)

". . . The present fossils leave no doubt whatever as to the age of the beds between 2824 feet and 2904 feet. Between these levels the strata encountered are lower Upper Cambrian, definitely pre-Davis, and are to be correlated with a portion of the Bonneterre at and slightly above the fossiliferous horizon exposed along the Farmington (Missouri) anticline. Inasmuch as you state that the samples were much the same from the Cretaceous contact at 2230-35 to 2390, it would seem probable that the entire 700 feet might reasonably represent the Bonneterre, especially when one considers the thickness of that same formation around the St. Francis Mountains and the known tendency of the Ozark formations to thicken up in the troughs around the Ozark dome.

"In terms of East Tennessee stratigraphy this would be the equivalent of certain beds in the Nolichucky shale.

"In making the more definite assignment the most significant evidence is given by the trilobites. In eight of the samples I found specimens of a peculiar group of small trilobites known as Agnostids. These have a world-wide distribution; are especially abundant in Upper Cambrian formations; are rare in early Ordovician; and became extinct before Middle Ordovician time, so that the mere finding of Agnostids in abundance not only eliminates all possibility of late Paleozoic age but is pretty good evidence of Upper Cambrian. This group is divided into a number of genera, several of which have limited ranges, and thus are excellent index fossils. One of the most striking of these is *Glyptagnostus,* specimens of which were noted at 2858, 2860 and 2862 feet. (See Butts, Geol. of Alabama, Spec. Rept. 14, p. 76, Pl. 9, figs. 5, 7, here called *Pseudagnostus;* also Resser, Geol. Soc. America Spec. Paper 15, 1938, pl. 10, fig. 23; same specimen as the one figured by Butts but renamed). This, as far as I know, is the first recorded occurrence of this genus west of the Appalachian trough. Resser makes this zone highest Nolichucky, but some of us who are familiar with the region are inclined to disagree with him and place it about the middle of the formation.

"Another very characteristic Upper Cambrian Agnostid is *Oedorhachis,* specimens of which are found in samples from 2880′, 2884?′, 2896′ (very good) and possibly 2902′. For illustration of these forms see Resser, same paper, plate 10, figures 16, 22, 24-26, 28.

"Still another characteristic Upper Cambrian trilobite is *Kingstonia* which is represented by two specimens in the sample from 2904. This form is rather common at many of the Bonneterre localities."

Tentative Identifications by J. Bridge from selected samples submitted by the Missouri Geological Survey.

Depth, Feet	
2824	Brachipods—dorsal valve of *Acrotreta* sp.
2858	*Glyptagnostus reticulatus,* excellent specimen to show markings, but cannot determine whether head or tail.
2860	*Glyptagnostus reticulatus* and pygidium, *Oedorhachis* aff. *tennesseensis,* trilobite fragment.

Henderson Oil Company, Markham No. 1 well—Continued.

Depth, Feet	
2862	Pygidium of *Glyptagnostus reticulatus.*
2864	Fragment, almost certainly *Lingulella* sp.
2875	Fragmentary brachiopod and trilobite, the latter probable an Agnostid; pygidium of a trilobite, possible *Kingstonia,* sp., fragment, possibly a cystid plate.
2877	Cephalon of an unidentified trilobite.
2880	Impression of a cephalon similar to the one in 2877, fragment of a trilobite, possibly *Oedorhachis. Lingulella* sp. fragment.
2884	Protaspis stage of a trilobite. 2 fragments of cranidium and free cheek.
2896	*Oedorhachis* cf. *tennesseensis,* good pygidium. Spine of a trilobite (*Crepicephalus* or *Tricrepicephalus* ??); fragment of a thoracic segment of a trilobite; brachipod—*Acrotreta* sp., dorsal valve.
2902	Protaspis stage of a trilobite and fragments of other trilobites.
2904	Pygidium of *Kingstonia* sp., fragment of brachipod.

***Reelfoot Dome Oil Company, K. Wright No. 1 well. Location: 3.8 miles N 19° E of the town of Tiptonville, Lake County, Tennessee. Elevation: 307 feet. Completed in 1920. Well No. T7 on map, Pl. 1.**

	Depth, Feet
Top of Porters Creek	1265
Top of Cretaceous	1620
Top of Paleozoic	1974
Total depth	2075

NOTE: No samples available.

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